City Planning Master's Thesis

Positive Impact of Technologies in Social Housing Projects

−Opportunity to overcome the unsustainable economy of new formal families and communities−

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Graduate School of Environmental Studies

Seoul National University

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Carlos Raul Castro Pedraza

Positive Impact of Technologies in Social Housing Projects

−Opportunity to overcome the unsustainable economy of new formal families and communities−

Name of Examiner: Prof. Young Song Lee

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Graduate School of Environmental Studies

Seoul National University

Department of Environmental Planning

Carlos Raul Castro Pedraza

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Carlos Raul Castro Pedraza
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Chair _____(Seal)

Vice Chair _____(Seal)

Examiner _____(Seal)

Abstract

This research shows how new technologies can develop a role of social inclusion and enhancer of economies in low-income people in a framework of housing public policy and affordable housing theory, contrasted with the theory of the disruption of technologies. It argue that there are benefits that the behavior of the technologies through the latest decays make affordable the technologies in prices and usage terms to link up the benefits with low-income people and contribute to solve social issues as the unsustainable economies among the massive provision of social housing in under developing countries. The research develop a deductive methodology that generate a first premise what is related with the vulnerable conditions of the families to overcome the poverty circles by themselves and only the provision of the housing and the capacities of community to develop economic activities. As second premise, the capacity of disruption of technologies can social issues that finally generate positive effects in social housing projects in developing countries.

Keyword: Social housing, affordable housing, technologies, low-income families.

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1. Introduction

Governments of developing countries have to face big challenges to provide suitable conditions among the population. By one side, the social issues represent the main purpose of the existence of the Estates, aimed to provide quality of life for and supply necessities. By other hand, regarded with the innovations, how they can implement the new knowledge to solve social problems encouraging the economic growth and sustainable development. Countries started to include the concept of "sustainability" in their public policies after 1988, when the Harlem Brundtland in United Nations published the document ""Report on Our Common Future" introduced to the world the necessity of develop our regular activities and supply all our needs without compromise the capacity of the future generations (Naredo, J. 1997).

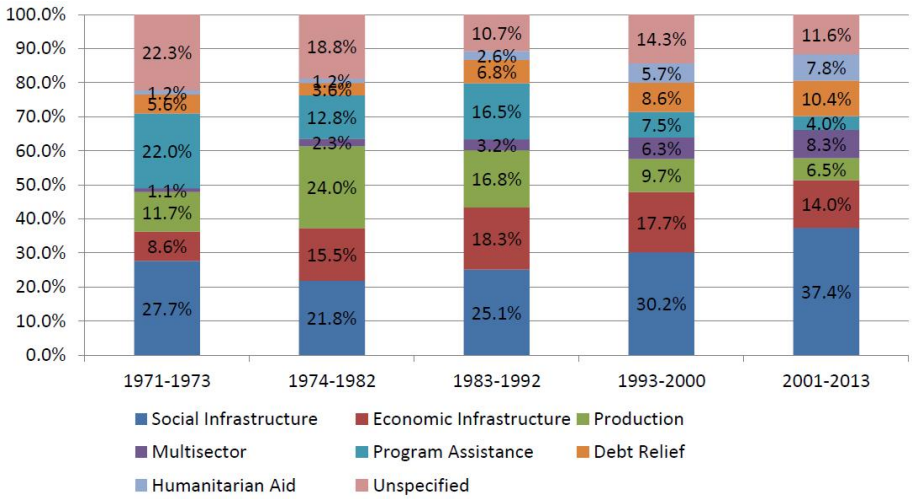
Tied to this concept, technologies got a key role in the overcoming of these challenges, preserving the environment at the same time that the human being make use of the natural resources.

Urban planning science is the field where planners are using the resources to make cities more equitable, healthy and sustainable among all the population. Cultural, social and geographical matters have influenced the history of the development of each country and city; therefore, it can help to explain why there are differences between countries, remarking social, economic and environmental conditions where the countries whose could use them in an effective and efficient way their resources, got better conditions along the time.

Countries that have created and implemented suitable system and techniques in the city planning process, could overcome social and economic challenges, increasing the experience and knowledge for making, implementing and assessment of public policies. This condition takes more importance in the international context where the most advanced countries have recognized that some current local issues go beyond of the borders and in some fields, like environmental affairs, the problem of one country has implications over the international community.

These conditions have become to the urban development a key sector for the international cooperation, understood it as a supporting strategy to developing countries to overcome difficulties related to poverty, inequity, economic development, and sustainability. Since different approaching, the investment in infrastructure, especially in social infrastructure, has increased significantly in latest years, and the international cooperation is a sample of this, where international entities organizations such as Non-governmental or Governmental have encouraged the development of social infrastructure in developing countries to achieve the social and economic goals according to the sustainable development:

Graph 1. Composition of DAC ODA by Sectors



Resource: Hyeok Jeong (2016); International Development Cooperation Policy and System.

This measure is considered as "Keynesianism" notion of urbanization (Yifu Lin and Doerte Doemeland, 2012), where the government makes huge quantities of investment in infrastructure to ignite the economic development, providing employees to build the social infrastructure.

Considering the role of the housing for each person, family and community, especially in low-income families, the provision of socially affordable housing impact considerably the social segregation, improve the quality of life and ignite the economic growth. Nevertheless, housing public policies in developing countries do not make economic sustainable families and communities, because the provision of social housing does not guaranty the poverty overcoming of low-income families.

2. Theoretical framework

Programs such as "Los con Techo" in Chile (1984), "Vivienda en Comodato" in México (1989), and recently in Brazil, the program "Minha Casa, Minha Vida" (2009) and "Programa de Vivienda Urbana" in Ecuador (2013), are some samples of the trend of public housing policy in South American countries, tackling the "Housing sector" like a strategy for support low income families and develop their economy. Colombia is not the exception and recently in 2012 implemented a radical program to provide social housing for the most vulnerable people in this country, looking for reducing the poverty, strong social exclusion, and shortage housing.

After 4 years of the implementation of the Free Housing Program, the government got unexpected results. One of the most critical is the new conditions of the families in the social housing projects, where beneficiary families seem do not overcome the poverty and anti-social behavior conditions characteristic of the informality of the previous settlements and in some cases, they present new social and economic problems, as Rodríguez Alfredo and Sugranyes Ana (2004) mention:

> "…During the last fifteen years the massive housing production has managed to reduce housing deficit, and many Latin American governments are imitating it financing model. However, this successful policy has ended up by creating new urban and social problems: segregation, fragmentation, insecurity, overcrowding. Consequently, it is pointed that a proper housing policy must currently include new criteria, mainly related to the quality of the product, the locating of the built neighborhoods and beneficiaries residential mobility…"

After to solve the low levels of the social housing supply, views are over how to support the families in the new housing, making economically sustainable families and resilient communities. This is proof of the need of articulate public policies in different fields with housing (Health, commerce, housing, transport, etc.) making integral developments. Three theories could be analyzed as a reference of the issues of social housing in Colombia, as a study case of underdeveloped countries:

a.) The 28% of the population in Colombia is in poverty conditions (DANE, 2016), the reason why Government prioritizes the provision and construction of social housing based in the subsidy scheme, mainly focused in the demand and limited by the available resources. According to Lenka Sobotová (2016), the current housing public policy tries to respond to the informality problem, focused in access to a formal housing and provide its property rights, what requires a big effort for the provision of new infrastructure, limiting the investment in other areas as social exclusion and economic involvement of the community.

b.) Through the ownership of housing provided to low-income families, governments could eradicate anti-social behaviors in poor communities (Pérez, Sáez, and Trujillo; 2002), which help to preserve social and physical components. Crime and delinquency characterize some communities, reason why is important that the new infrastructure includes components that involve and converge to the communities. In the cases of the implementation of technologies in low-income neighborhoods, it can represent a high risk of to be stole or damage if there is

not the appropriated influence and manage the community but it also can represent the opportunity to generate social capital against anti-social behavior.

c.) Since the boom of the technologies as result of the third industrial revolution and the globalization phenomenon, the discussion over the impact of the technologies in low-income is still under development. This theoretical discussion seems to continue due to the faster evolution in comparison to the adoption of them by communities. But at the same time, this is the challenge of governments and communities to create positive impacts among low-income communities (Wallace, R.1991). In order to generate positive impacts with new technologies, low-income people should play an active role as producers rather than passive users, improve the dialogue between public agencies and low-income neighborhoods, encourage the entrepreneurial potential with technologies and create education and links between these communities and new technologies (Donald A. Schön; Bishwapriya Sanyal; William J. Mitchell 2001).

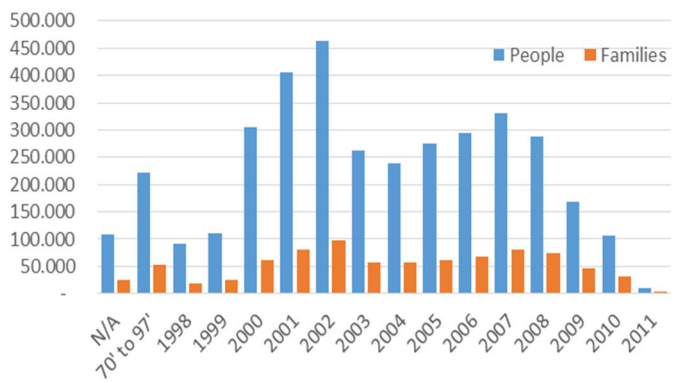
2.1 Statement of the problem

The persistence of poverty and social exclusion in social housing projects:

In spite of governments in underdevelopment countries provide through different programs formal housing to low-income people whose cannot afford it, the social exclusion persist among social housing projects. Housing policies as considered as a key strategy to overcome the poverty and social exclusion but not providing economic opportunities and social inclusion to these projects, makes poverty and social exclusion remain. The fight against social exclusion and poverty must be tackled by attacking a set of inter-connected social and economic disadvantages that low-income families are experiencing (Burchardt and Huerta; 2008).

As a case of study, the Colombian case could be present especial characteristics, marked by the creation of guerillas in the 50' years, as a cause of the campaign of conquest developed by socialism and capitalism waves along these years. In the middle of the 80' years, these armed groups found in the traffic of illicit drugs the opportunity to fund his activities and these new activities of the guerillas in rural areas brought violence in the Colombian territory (Gueduez, R; 2001).

Graph 2. People and families displaced from rural to urban areas



From: SIPOD- National Integral System of Displaced People, 2012

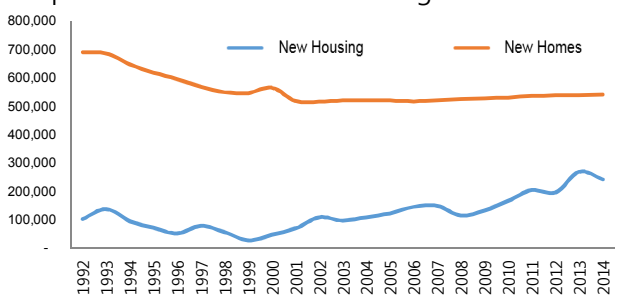
These facts resulted in a massive forced displacement of the population from the rural to the urban areas.

In 2011 Colombian government

registered 3.7 millions of people whose was forced to abandon their farms, houses, works, and networking, moving toward the main cities as a shelter against the violence.

The social capital of these communities was destroyed, and when they arrive in the cities without resources for access to formal services such as housing, education, transport and also the opportunity of employment, they suffered a process of social exclusion. The displaced families resettled in suburban areas where the price of the land is very low, but in majority of the cases, the affordable houses do not fulfill the minimum standards required, such as access to energy, water, not suitable materials and unstable legal security of the tenure, finally making more vulnerable to the families.

Graph 3. Production of new housing vs new homes



From: DNP and DANE Colombia2015, own calculations

One of the most important effects of this phenomenon is that these new settlements did not have the suitable infrastructure like roads, transport, public services, schools or health assistant, making more difficult the creation of social capital, the process of innovation, or the capacity of organization among them self. In stressed conditions, generated by poverty, overwhelm the critical-think skills that people need to overcome the difficulties (Babcock, E; 2014). These hard conditions get worse the problem of quantitative and

qualitative shortage of housing, explained by the huge gap between the production of new housing and formation of new homes.

The provision of social housing has been limited to the construction of the infrastructure, resulting in the concentration of the poor families in social housing projects characterized by poverty circles, social exclusion and in some cases foster the deterioration of the infrastructure what represents an additional cost for the government (Acosta, K; 2015).

Thus, the problem is that when families move to formal housing, informal economies remain, and the new housing, instead of representing a tool to get new opportunities, becomes in an additional burden for economies of the families. In addition, the problematics can be linked to the non-integrated social infrastructure provision among others fields such education, commerce or health. Then, the problem lies in how governments can integrate strategic components to make sustainable families and communities.

3. Research questions

The quality of life of households and their economy is strongly impacted by housing conditions. Thus, housing programs represent the opportunity for governments to improve the social and economic conditions of low-income people. Thus, governments seek to provide affordable housing with the challenge of achieving sustainable economies in families and new communities. For sure, social policies demand investments but considering the high levels of housing deprivation in developing countries,

these countries implement programs whose require less possible resources it reaching more population as well as possible. This idea implies, in most of the cases, the provision of housing through basic tools like the subsidy of housing (Partial or complete).

Low-income families can access to the housing with governmental aids, reducing the first dwelling's financial barriers and considering as reaching affordable housing for low-income people. Even though they can access to an own housing, they keep limited by economic conditions, as well, they have not resolved the incomes situation and instead of this, when they move from informal condition to a formal one, the new expenses associated to the formality, force to adjust their living expenses in health and education, in some cases depriving key fields to overcome the poverty.

By another hand, the innovation and technology field is leading the solution of social problems, especially considering the evolution of technologies along of last 3 decades, which have shown a continuous decreasing of prices in technology markets. In this way, considering that several decades ago the price of technologies were high, they could not be applied in social housing as a tool to solve certain problems, but now the world face other reality which can represent opportunities for developing and developed countries to make complementary functions where each one can take advantage of this new panorama. Thus, the research question is addressed to find: How could new technologies encourage low-income families to overcome the unsustainable economies from the social housing projects?

3.1 Hypothesis

The exponential decrease of the price of technologies can made affordable its implementation in social housing. Consequently generating positive economic effects among low-income families reducing the risk of failure of social housing projects and public policy.

3.2 Research objectives

The objectives are addressed to contribute with practical ideas to complement the social housing public policy in Latin American countries which has a tendency of provide the infrastructure (housing) in a massive way, without considerer additional components what beneficiaries (low-income families), present at the moment of make use of the new formal housing.

- Contribute strategic solutions that help to broke up the poverty circles generated by the social housing projects in developing countries, in the public policies framework.
- Identify how in a modern world full of innovation and technologies, the social housing projects can become in a social and economic engine in the low-income families.

- Identify how technologies can help to reduce the cost of the use of the social housing and how to them generate incomes to these families.
- Contribute to social and economic models that help to encourage the social capital and resilience of low-income families in social housing projects.
- Provide a clear panorama of technologies in nowadays, showing opportunities and benefits for them to solve social issues.
- Contribute to models of social housing what involve low-income people in the new era of technologies and provide tools to eradicate the social exclusion.

3.3 Research justification

The objective of the public policies of the different governments have to be dynamic and adjust themselves to the new needs and challenges that nations face over the time. To improve the conditions of the families in developing countries and theirs precarious living standards in the poorest segments of the population, like in the Colombian case, requires of innovation at the moment of pose solutions around the social housing, where it is understood as something more than just a shelter of each person (Greenop, K.; 2018). Instead of this, it should represent an opportunity to generate social capital and chaining production where families and communities can harness the final products and the different

process that occur in the daily life with the goal of taking them self out of the poverty.

This vision finally could give a solution to one of the most recurrent problems faced by developing countries at the moment of providing and allocate social housing projects: how to make economic sustainable the families after the transition from informal to formal housing.

Because these programs of massive production of social housing are relatively new, like in the case of Colombia (2013), Brazil (2010), and Mexico (2009), the studies about how to make integral policies around housing programs, are still in discussion. In addition the technologies usually are associated to high cost and in the case of green technologies, these are limited to function of saver of energy and reducer of the public services cost (energy and water), around the housing matters. This can be explained because currently, technologies are implemented in cutting-edge processes and very advanced processes, limiting the idea and researches about additional benefit of these technologies and how they can be implemented in the social housing field.

With the theory of disruption, the innovation can make us go beyond of the idea that technologies are only for powerful people or only with complex process.

4. Contributions

The contributions are addressed to provide clear and real criteria about the limited formulation of public housing policies in Colombia, as a sample of the trends in Latin America. In this way, this research is going to conduct to prove that governments are developing limited policies that do not encourage to the low-income families to cut with poverty circles generated by the grouping of poor people in a same. To group people with vulnerable conditions and deep social disorders result in violence, anti-social behavior, lack of social capital among others. Analyze how to mix social housing, communities and technologies contribute to the governments to think about innovated concepts of the social housing, especially in developing countries, where the housing deficit have not been overcome despite many efforts and large investments.

The gap between developing and developed countries is in certain factors as administrative skills, and mainly in how they innovate in the solution of the problems. In the current era of globalization and fast evolution of the technologies, the dynamics of simple process as communication, buy the food, healthcare, entertainment and transportation; adopt technologies as the most important tool. Mix social issues and technologies provide ideas about how to tackle incorporate low-income families in social and economic dynamics after phenomenon of social segregation caused by the globalization, where the polarizations is getting deeper.

This research looks to show the need of tying the allocation of housing with opportunities of work and inclusion of low-income families in modern

dynamics what will help to overcome the housing deficit. The housing, as the main good of any family, should enhance the skills and opportunities to develop a functional work among societies and communities. The reason why mix social housing issues with cutting-edge technologies could represent the bridge or link to all communities and families to innovate and participate in the current process of innovation. Thus, the first step is involucrate and familiarize them with the main tool of the current era: the innovation and technologies.

As an explorative research, it has a deep connotation in the framework of the urban development policies, where the adoption of the model of New Town as an urban planning model. This has not been implemented successfully because the new role of this model in emerging countries is based only on economic development, led it by private economic motives, where the vision of the developers predominate over the government interest and social ambitions (Provoost, M; 2013).

4.1 Expected outcomes

- The main required characteristics of one technology that allows implement them in housing among low-income people and find a key impact of them over the economy of these families and social benefits. Considering concepts of sustainability and resilience get an example of how technologies could be implemented to get benefits among the populations of the social housing projects provided by governments.

- Identify key components and issues that make feasible the implementation of technologies as a social and economic instrument in social housing projects.
- Potential schemes between the actors (government, population, and private sector); to build a structure that encourages the economic growth of low-income families through the implementation of technologies.
- Model of productive communities by the use of technologies, linked up to modern dynamics.

5. Social housing and low income families issues

The current discussion about how governments should provide the housing through the implementation of public policies, consider mainly the conditions and reality of the poor families in developing countries in order to overcome the difficulties that weak economies in poor families face to access and enjoy a liable housing. The diversity of the social housing, where enhance the skills of the community and people should be one of the principles of public policies at the moment of formulating programs that want to reach strong economies and communities (Escallon, C; 2012).

But in most of the cases, the limited resources of developing countries and weak administrations do not allow to innovate in the design and formulation of solution regarded to social housing matters. Instead of this, the vision of governments is limited to provide just the access to formal housing by vulnerable families. So, the provision of a subsidy addressed to

the access of the infrastructure cannot be considered as enough tool to solve a sustainable affordability of poor families (Hurtado, A; 2006). In this way, it is important to identify the most critical social and economic conditions of households when making use of new housing offered by the government.

5.1 Social housing in Colombia

As it was mentioned before, one of the most serious social problems in the recent history of Colombia is the armed conflict suffered in rural areas in its territory. Based in the serious economic and social situation of the displaced people in urban areas, and especially encouraged by the idea of extreme poverty people will not access to a formal and appropriated housing, the Government of Colombia in 2012 invested 1.7 billion of USD to build 100.000 social housing in the whole country. The program supported in the construction capacity of the private sector, to encourage the economy through the investment in infrastructure. The economic goal was achieved, and GDP grew up 4.9% between 2012 and 2013, explained principally by GDP of construction (DANE, 2015).

The program is focused on providing social house like a subsidy to families that have been victims of the armed internal conflict in Colombia from different cities and regions of the country, whose have been displaced by the violence, are not homeowners and, have not received a subsidy previously. In total were built 100.000 houses with 50 m^2 as average, 283 projects in 205 municipalities. Also, is important to mention the size of the

projects because 22 of them exceeded 1.000 units, highlighting the fact the government made new neighborhoods.

But, what about the internal social process of these projects? One of the highest worries about this public policy is the current social conditions, where started to appear innumerable complaints about this projects, such as gangs, crime, violence, and lack of work opportunities. The "free social housing" program is a sample of main criteria of the public housing policy in Colombia and Latin American countries, where the poverty and habitat conditions, are interpreted just like the provision of the infrastructure (Housing), through the allocation of subsidies.

The notion as a public policy, limited the wide vision and importance of this good for family, understanding the infrastructure like the strategy for the provision of social services and generator of economic development, social integration an social capital in order to enhance the quality of life.

In the frame of the public policy, the social housing in not only generated by the public sector, it also can be developed by privates whose can participate freely in a free market, and in some cases, with the financial supporting of the government and hardly by private financial entities, low-income families can afford one of this housings.

Considering that social housing receive special preferences and treat, this kind of housing is defined by the price, which cannot overcome the 70

legal minimum salaries. By the side of the families, they can not have incomes higher than 4 legal minimum salaries, they should not have received a housing subsidy previously and, in the case of displacement of people, they should be registered in the national registry where all the conditions of the family such as members, ages, and kind of violent displacement suffered, are known.

In this way, the provision of housing must be marked by social and economic components that enhance the condition of the families, not only by the physical conditions but overcome the economic and social poverty among these communities.

5.2 Affordable housing for low income people

In Latin American Countries, the meaning of affordable housing has been framed and linked with the concept of accessibility. In this way, the public housing policies have been focused to reduce the shortage of housing, especially among the families that can not afford or access one formal and decent housing, and instead of this, are limited to live in inadequate housing. The problem has been understood by the unmatched between the income of the poor families and the price of the housing. The answer of the governments in Latin-American has been to allocate subsidies to these families that allows the access to the housing (Tapia, Z. 2006).

In a wider concept, the housing affordability should be closely related with

the resilience, especially when it is about social policies. Housing policies should be designed with resilient components, which make communities better equipped to enface environmental, economic and social threats (Lawrence J. Vale; Shamsuddin, S. Gray, A. 2014). Thus, the meaning of housing affordability should be integrated strong component over the economy of the families and communities, which represent the biggest issue for the affordability and sustainability over the time.

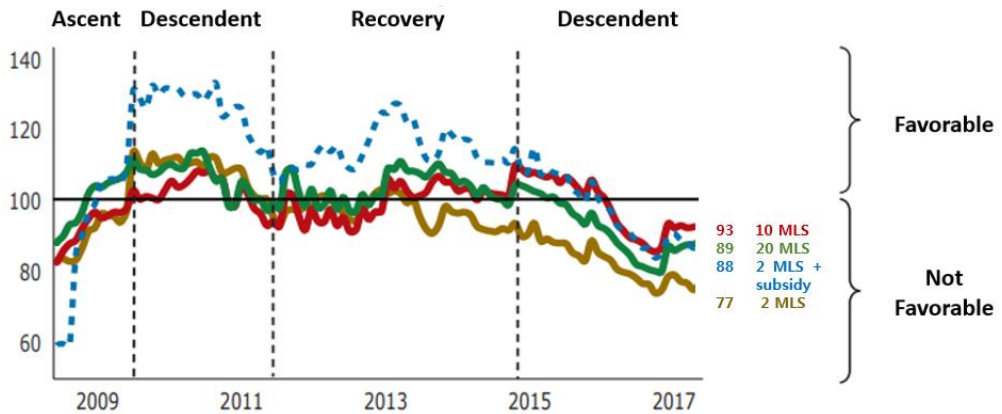
In the 33rd National Convention of Architectural Engineers and National seminar on "Architectural Engineering Aspect For sustainable Building Envelopes" developed in Khairatabad, Hyderabad India, the concept of affordable housing in under developing countries was associated to a wider concept. The affordability should be considered in economic terms of designs of individual buildings, layouts, cluster etc. (Kumar, V., Dongre, A. AND Srinivas, G. 2017). This meaning includes a longer concept about the functioning and usage of the infrastructure to encourage to the families to get better living conditions.

5.3 Housing affordability in Colombia

The housing affordability in Colombia has been showing a tendency to fall since 2009. The affordability index in Colombia by segments of level incomes shows that the subsidy provided by the government, has improved the indicator, but over the time can be seen a deterioration of the index for families with a subsidy (See graph 5). Similar tendency presents the index on families with two minimum legal wages, whose have the worst affordability in the population. This index is calculated based on the minimum legal salary of the respective year as a numerator and the

price of housing index as a denominator.

Graphic 4. Affordability Index in Colombia



Resource National Association of Financial Institution of Colombia. ANIF-2017

*MLS: Minimum Legal Salary

In any case, is clear that low-income people in Colombia have difficulties for access to the housing, especially when in the latest 10 years the housing price index in has been increasing to a pace of 10% as the average per year. It is also explained by factors such as:

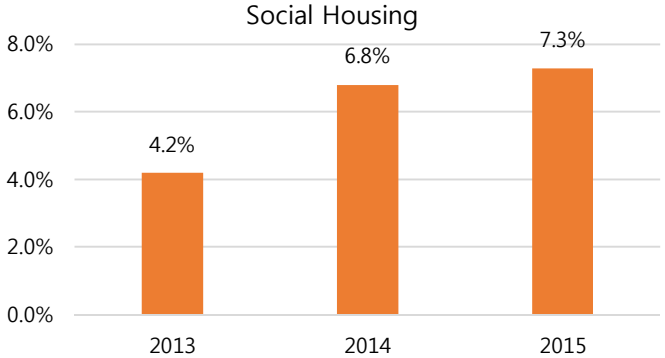
a). Low-income families do not have the option to save money because the gap between income and life cost.

b). Save in formal banks brings additional cost that low-income families do not wish to pay. It represents an impediment to get a loan and buy a house because the bank does not have the saving score for this family.

Even though one family can access to the housing, how it has been promoted by the program of subsidy, the economic condition could get worst when families whose passed from an informal settlement to a formal housing, now have to pay other expenses as taxes or public services (energy, water, gas and other services related to the maintenance of his property).

These new conditions give rise to new challenges that families do not know how to face, because they do not have the appropriate tools in their knowledge or in their environment, including the infrastructure, to overcome these economic and social challenges in a resilient and sustainable manner. The situation is that the income remains at very low levels but the expenses increase. Thus, for example, the beneficiaries from the program of Free Social Housing have to abandon or sub-rent his new formal property for return to the previous settlement where they had zero expenses and also the had a consolidated social networking.

Graphic 5. Proportion of housing sub rented or abandoned in projects of Free Social Housing



From: DPS-Presidency of Colombia Colombia-2016

Families that can remain in formal housing have to redistribute income, reducing resources in

food and health, mainly. This means a social detonator that creates vicious circles of poverty and has repercussions on serious social problems such as juvenile delinquency, drug trafficking, gang creation and especially the low economic productivity of these neighborhoods, which is reflected in social exclusion.

5.4 Social housing public programs and public policy: solutions and new challenges

A partial solution: Program of free social housing for vulnerable families

Based in the serious economic and social situation of the displaced people in urban areas, and especially encouraged by the idea of extreme poor people never will not access to a formal and appropriated housing, the Government of Colombia in 2012 invested 1.7 billion of USD to build 100.000 social housing in whole country, making a partnership with the private sector for encourage the economy through the investment in infrastructure. The economic goal was achieved, and GDP grew up 4.9% between 2012 and 2013, explained principally by GDP of construction (DANE, 2015).

The program is focused in provide social housing through a subsidy to families that have been victims of the internal armed conflict in Colombia from different cities and regions of the country whose have been displaced

by the violence, are not homeowners and have not received a subsidy previously. In total, were built 100.000 houses with 50 m² as average, 283 projects in 205 municipalities. Is important to mention the size of the projects because 22 of them exceeded 1.000 units, highlighting the fact of these project's size can be considered a new neighborhood and the impact on medium and small city is significant.

One of the highest worries about this public policy is the current social conditions, where started to appear innumerable complaints about this projects, such as gangs, crime, violence, and lack of work opportunities and almost zero incomes.

This research is aim to provide some key concepts according to the social and economic conditions of the Latin American countries and developing countries in general, to be integrated in the public policies, programs and projects that provide social housing as a strategy for enhance the living conditions and overcome the social exclusion among communities.

In this way, the provision of social housing in developing countries is one of the main issues on the government's agenda but, if the New Town will provide housing to medium and high levels, they will face problems of interest that they can finally discard its execution.

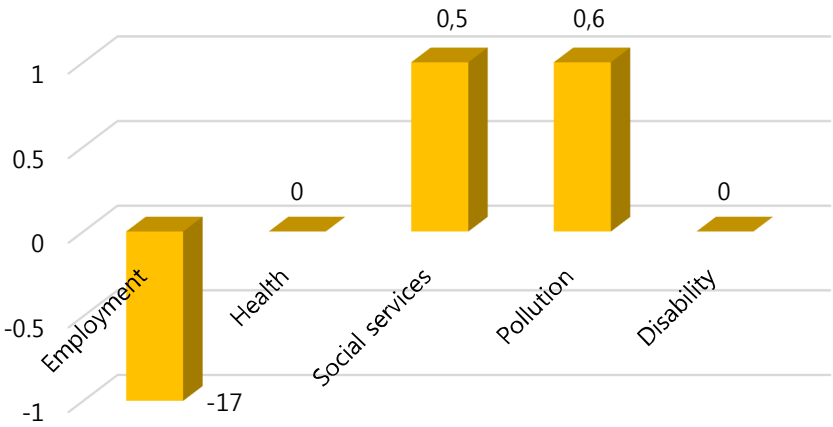
5.5 Economic challenge for new formal families

In spite of the big efforts of Colombian government to provide a social housing totally free to the poorest families in Colombian, these new conditions require to be evaluated to understand the main barrier to link up to formal works.

In order to understand the main barriers to link up with formal dynamic in the new areas, is important to check the accessibility of these families to different social services after they moved to the social housing project provided by the government, and identify what are the most negatively impacted with this new location.

Considering as a sample of the social housing projects one who is located in the municipality of Girardot, province of Cundinamarca, Colombia, called "Villas del Sol", which has 608 housing (Apartments), the accessibility index has an average of -3,18, where the worst component is the employment (-17,0) accessibility, followed by health and disabilities (0,0), pollution (0,6), and social services (0,5).

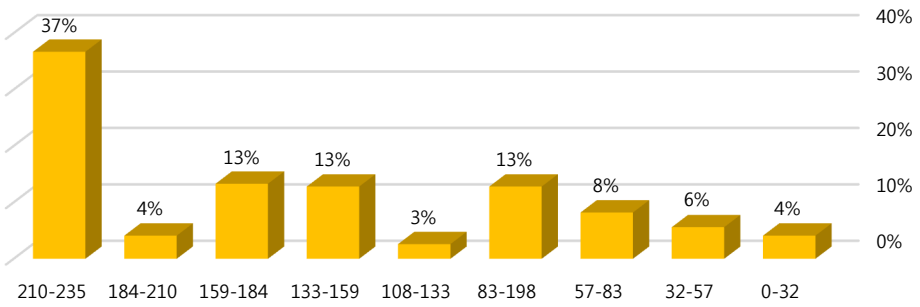
Graphic 6. Social accessibility index in social housing



Source: Luis Alberto Nieto-Ñustes, Luis Fernando Serna-Hernández, Efraín Enrique Granados-Perdomo, Efraín Pastor, 2014.

This index allows to interpret as a first hint about what is the problems of these new communities by each family, regarded to the employment, which of course impact directly the incomes of them. The low accessibility of these families to the employment is reflected in low incomes, where the 36.7% of these families highest income per one family is between 210 and 235 USD per month. The rest 63,3% have incomes between 0 and 210USD. The conditions of poverty are notorious when the average of people per housing is 5,1; which confirm the critical economic conditions of these families and new communities after the relocation to formal housing.

Graphic 7. Average Income of families in social housing project (USD)



Source: Luis Alberto Nieto-Ñustes, Luis Fernando Serna-Hernández, Efraín Enrique Granados-Perdomo, Efraín Pastor, 2014.

Is important to mention that the national level of the basic good needed in Colombia per month is around 72USD in 2013 (DANE, 2013), and considering the average size of the families could be conclude that these families remain in conditions of poverty, and carrying with them dynamic of social segregation. Comparing the above incomes with the levels of the World Bank, the 4% of the families living in these projects are under the line of the extreme poverty while the rest 96% are considered as families in the range of the poverty (World Bank, 2106).

This panorama hardly allows overcoming the conditions of the poverty, providing merely the housing as a subsidy, due to they can not satisfy the unsatisfied basic needs, enhancing the living conditions and create a suitable environment to link up with positive economic dynamics in the formality. According to the Vice-presidency of the Republic of Colombia (2015) in the strategic of a provision of school to social housing projects, in several round tables developed with beneficiaries communities, one of the most risky issues is that coming to live in these projects, they have to redistribute their incomes in pay public services, that they were not get

used to pay and incur in additional cost of transportation, especially when they have to pay around 2 USD per the round transportation of their children to the closest school, and like in the case of one of the beneficiaries, they have to pay around 6 USD per day because in their home are 3 students (Beneficiary of Free social housing program, 2016).

In other words, the new location of the family in the formal project is not a clear and enough solution to overcome the poverty and enhance the habitational conditions. Instead of this, due to the low incomes, lack of employment and opportunities of education, innovation and learn about the key factors of the modern world, instead of this the formal housing become in additional burdens for these families.

Table 1. Description of Social-Economic conditions in social housing projects

Indicator	Values
Average age of beneficiaries	41,6 years (Min. 19 and max. 86)
Average of children per housing	2,6 (min 1 and max. 6)
Average of habitants per housing	5 (min. 1 and max 15)
Procedure	Homogeneous for each community. Approx. 20%
Handicap average	0,3 (One housing reported 6 handicap people)
Predominant work kind	Employee 40% / Various jobs 27% / Sales 33%
Place work	Different places
Genre	61% female; 39% male

Source: Luis Alberto Nieto-Ñustes, Luis Fernando Serna-Hernández, Efraín Enrique Granados-Perdomo, Efraín Pastor, 2014.

The condition of these families in the new formal housing show that they are families that are in active work age and try to keep economic activities

as employees, sellers, and other activities that they can develop by them self and that are the result of self-capacitation.

One of the various cases reported by the Vice-presidency of Colombia according to the roundtables developed with communities (2016), and the observation of the social housing projects along its 4 first years of its implementation, was that most of the families were not familiarized with the dynamics of the new infrastructure (located in urban areas). As a result, common tools of the house such as taps, energy switches, toilets, and common public spaces inner each building and public spaces as parks, parking, and communal saloons. This factor affects negatively the housing project and the community because the infrastructure suffers a faster deterioration.

As a curious example, in the revision of the project's infrastructure, they found that a toilet on the fifth floor was completely blocked by dirt, as they had planted plants because they did not know the functionality of the toilet (Vice-presidency of Colombia, 2015). This simple fact makes see the reality of these communities and at the same time explain why over the time it becomes harder to link up to them to formal economies, where these knowledge are the basis of the work. It could be considered in the same way as the technologies, where the daily life adopted as tools the technologies, and social capital is built through these too.

But, according to this fact, is important to understand that although each person and whole community account with certain capacities, they are not well addressed to adapt themselves to new dynamics, and through them

get innovation in the daily activities in different fields like transportation, communication, education and basic chores associated with the housing.

También traen consigo las diferentes actividades y negocios que hacen y esperan desarrollarlas de igual manera en estas viviendas donde las condiciones de espacio, accesibilidad y trato con los vecinos son importantes. As a referent, the internet as a media to access to basic information will be held to understand the access perception of beneficiaries, where the internet services considered as at least like with far access (66%).

Table 2. Perception of proximity of services associated with housing

Service	Very far	Far	Near	very Near
Facilities for handicap	20%	88%	7%	3%
Internet	3%	63%	31%	3%
Sewerage	1%	28%	55%	16%
Energy	1%	29%	53%	17%
Aqueduct	1%	26%	56%	17%

Source: Luis Alberto Nieto-Ñustes, Luis Fernando Serna-Hernández, Efraín Enrique Granados-Perdomo, Efraín Pastor, 2014.

5.6 Social issues among the new families and communities: Consolidating new communities

One of the most important challenges of governments at the moment of developing housing projects is creating strong and social capital at the moment of making massive programs of housing like social housing

projects. Governments are conscious about the strategic good that represents the housing but due to the financial and technical conditions, many times the governments consider as a housing policy as a merely infrastructure project leaving social and economic issues required to talk about successful housing projects and a suitable habitat.

In this way, the social and economic component is separated from the housing, and public social housing policies are concentrated only in the provision of the infrastructure. This statement can be considered also as one structural reason about why the housing policy does not consider an integral policy to enhance habitats among low-income families.

The daily life of families and communities are limited because the not-enough resources to develop new activities and added to this, the limited knowledge of the techniques used in nowadays where they can think about new ideas about how to solve daily problems and satisfy the common need in the framework of sustainable and resilient communities. Finally, they are who know the daily problematics and need and they are the suitable ones to provide the solution.

Talk about self-regulation in these communities is almost impossible because the background of violence and anti-social behavior persists in the new location. For this, would be necessary a measure of police control to form a new behavior. Police checkpoints or care centers to resolve conflicts, also require infrastructure, which was not incorporated in the new neighborhoods. Regarding the social supported level, is necessary a long

time to create a new identity and values for each person and these families came from different part of the country with other customs and identities.

Thus, the conditions of the community level will be the reflection of individual level. In this level, community level is important to mention that, as a new community in a new neighborhood where the families and people do not know between themselves, do not exist dense social network, or those that exist are very weak. This is one of the most serious gap in the program, because if the government doesn't have enough resources to implement programs to facilitate the access to formal economy, at least it can work about communities already formed and strength his social network that help to generate incomes, instead of breaking them relocating the vulnerable families.

The promotion of interaction channels and diversity plans among the community hardly could work because two components: First, the program only included families with the same social level, vulnerable and poor families. When the program relocate these families in the same place, it create poverty circles; and secondly, as a partial result of the first one, factors such as violence, social segregation, lack of opportunities and unemployment, people cannot develop a critical-think skills to overcome the simple and deeper difficulties.

6. Technologies as an urban instrument

6.1 The technologies in the urban development

The technologies include several visions and approaches that study any science, providing definitions and methodologies to define its field and performance. According to La Shun L. Carroll (2017), the science of technologies consists of the techniques and how they are used along the human being life. This concept makes a wider vision about how to implement the technologies in different fields, and considering, especially in this case, how they would improve social conditions, which are not in most of the cases related with social and cultural components whose are not tangible, like social capital, resilience, and values among others.

Is well knew that technologies have changed the civilization in many aspects through the beginning of the human history. In nowadays, the challenge is how to keep changing the human history in a positive way over the social, economic and political sectors. The most typical topics have been agriculture, weapons, industrial, environmental and communication development (Lendforf, W. 2015). One of the examples that allow understanding the impact of technologies on the civilizations is the experienced in the agriculture development, where the implementation of technologies in farming helped to the farmers to make more efficient and effective the process of food productions. It is a basic good required to survive and support the continuous growth of the population, mainly in the cities (Loendforf, W. 2015).

The ambit of the technologies in the urban development is tackled since several criteria: Management of the resources and site, renewal and alternative energy, sustainable manage of the wastes and include a notion of comfort among the built environment (Hernández, S and Garduño, A; 2009). However, technologies are not only considered as a protection instrument, it also should be compatible with the process of production and needs of communities and cities in a sustainable way.

This fact take relevance over innovated techniques, here like in the case of the food for feed people as an essential good for the human being, the technologies helps to the human to produce what civilizations or communities need.

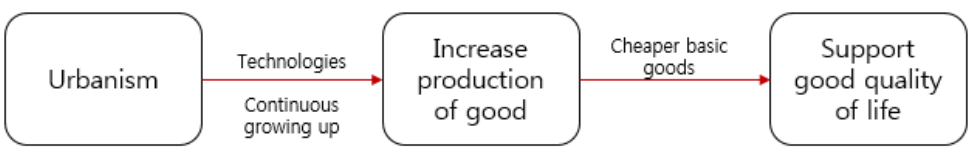


Diagram 2. Usage of technologies to support life in cities

Thus, the innovation in social fields are not only about how to provide the one service or final product, the new techniques and implementation of cheaper and better material imply that technologies have a longer process than just its application in the final product. The innovation in process means that they are more affordable over the time, and simple new techniques and technologies could be manipulated by not professional or specialized Scientifics, generating new opportunities of employment in this new era. This last point is an important idea that should be considered from the functioning of each technology.

The new settlements bring with them new infrastructure of factories and infrastructure that support the transportation, industry, and housing which will be used by workers. These three components have been the dependent variable to planning and design the cities. In the 20th century, the massive usage of the car demanded readjust the model of the urban development, including a large-scale notion to supply the space required to support the implementation of this innovation among the different activities of the city (IFHP, 2016).

After that cities adopted a model of Central Business District-CBD, and most of the most important cities around the world developed high rise towers, highways, and sprawling suburbs, new challenges appeared for the urban development, mainly focused on social issues to avoid the polarization of the population and economies. Now, cities are characterized and led by the use of the technologies for the manager of the data and the effective use of resources due to its limitations.

Thus, the concept of smart cities could be considered as a result of use of technologies in urban development. The opportunity of implement more technologies and supply needs and preferences among the different actors as private sector, consumers and public entities, brought the fourth industrial revolution, where the faster adoption of the new-era devices, especially in the field of the communication and information. This facilitate the use among all the population in all dynamics, and the interconnectivity between all the devices for the generation of precise data about needs, preferences and dynamics in the new cities.

Another important point is how technologies are interrelated with society and cultural factors. According to the historical perspective of technologies of Loendford, W. (2015), when technologies supply needs and people start to adopt it in daily activities; technologies disappear to the eyes of the citizens, becoming invisible in a progressive way for societies and their cultures. This fact is the proof of how the human being gets use to the use the most advanced innovation as a common tool to solve needs.

However, the adoption of technologies has not been a process that could start randomly or sudden, it should be introduced progressively inner the communities through each activity for finally get his invisible adoption. The evolution of technologies represents by itself the opportunity of influence positively the low-income families and create communities around this process which is supported in the continuous learning capacity of people.

The main barrier of the introduction of new technologies and innovation is that they are associated to a capitalist model, which has a huge variety of products and services and is well accepted by most of the people. However, this model is focused to economic growth without consider the social and environment global changes that it produces (Cottey, A. 2014), in this case, the social segregation to which the communities are exposed.

At the beginning of 20th, Nikola Tesla identified the main trends of the contemporary development of cities around the world, considering that

human being is consuming more energy over the time, at whit it more resources, reason why energy will be consider as a critical factor for keep the suitable functioning and growing up of the cities. As consequence, the innovation should focus on (Jovanovic, B; 2015):

- Preserve energy resources;
- Search for new, renewable and alternative energy sources;
- Strive for a more modest development with less consumption;
- Aspire a culture oriented to universal mankind values, true education and true culture;
- Weigh toward the poor life habits change and even development of all people

The capitalist model in the creation of technologies seems to be the factor that makes lose the importance over the current needs, especially in the aspect of think about technologies as a tool that builds cultures and universal values, which requires the easy access of technologies for every people. In this way, could be understood social issues as social segregation as result of a capitalist model more than the implementation of technologies by them self what means that these (technologies) could be used as a solution to solve issues tied to the economy and social aspect of the cities.

The international context of technologies provide two important components to highlight as possible instruments to link the benefits of the technologies with the social housing and low-income people:

1. Technologies as tool for increase the level of production of goods and services at the same measure of the population growth, harnessing not only the final product but the process of its implementation too, and;
2. Technologies as a tool that does not provide social segregation in a capitalist model and, instead of this, the innovation provide sustainable development and performance of social and economic engines.

6.2 Usage and objectives of the new technologies

To talk about new technologies is important to differentiate it from that is considered as old technologies. In terms of technologies, Christina Haas developed a compilation of concepts about new and old technologies (1999), to understand how to understand the old technologies. Hass refers to the importance of the technologies among the society and it is what is providing the technological changes over the time, guided by the societies.

In this way, the question, what technology is new or not? Becomes more complex when is not only considered the physical tool, also its function.

According to this meaning, technologies evolve in its materials, efficiency, and power, but the function keep being the same, for the same purpose. Technologies are tools that create systems about the relation of the human been with the resources and needs, made by the hand of the human been which are tied to social, historical and cultural practices. This close relationship makes hard the replacement of old technologies with new technologies giving a different notion among the societies. Thus, technologies evolve at the pace of the society.

Then, old and new technologies cannot be interpreted separately or mutual exclusive, they need to be understood by the function and its performance around physical characteristics and efficiency. The evolution quality and efficiency generate additional opportunities that can be understood according to the kind of process needed among the society. Then, is important to define hard and soft technologies in order to understand more about its process and product:

- ***Hard technologies:*** This kind of technologies have been understood as a tangible thing, usually expressed by machines and equipment, those are the final product of a previous process and now are employed in a new production process (Clark and Staunton, 1998). According to Morkyr (2003), they are also referred to as artifacts.

- ***Soft technologies:*** are those whose product is not a tangible object and they pretend to enhance the functioning of institutions and organizations through its application and get better results, it is the

result of the gradual and deliberated approach of acquiring the knowledge embodied with the technology (Dobler et al., 1990; Lamming, 1993).

There is a wide spectrum of cutting-edge technologies, who according to the World Economic Forum (2016), and mixed with the "social consciousness", are taking a new key role in the fight against social issues around the world. The Meta-Council of Emerging Technologies Forum of the World Economic Forum in 2016 published a list of the most important technologies considering factors such as they can "improve lives, transform industries and safeguard our planet" [1] and the cost component which is important for the implementation in social housing projects for low-income people. The list also includes the dynamic of technologies over the latest years, whose started to appear more frequently in the common life even though existed several years ago.

In order to classify the technologies in groups according to the products and services among the daily life of low-income families and communities, will be considered as a first step, these new technologies in 2 types: hard and soft technologies.

In addition, it will be recognized the main field of its application to approach it implementation in the common life and facilitate the feasibility analysis in new communities in social housing projects.

[1] https://www.scientificamerican.com/report/the-top-10-emerging-technologies-of-2016/

Table 3. Technologies developed in 2016 and 2017

	Technology name	Function and objective	Mainly used field	Type
1	Nano sensors and the Internet of things	The creation of sensor enough small that now can go through the alive bodies or in some cases they can be mixed with construction materials for identifying disease or to get another information in a no invasive way in bodies or infrastructures. The internet on these days is able to catch behaviors and images, whose are addressed to exchange data around the entire world. This net is fed by devices that can connect to the internet. This could be considered as the mix of hardware and software to provide better and cheaper services.	Health and communication	Hard technology
2	Next Generation Batteries (Energy storage)	The inclusion of new materials as ions of sodium and air-zing are much efficient these days in comparison with previous battery generation and at the same time are cheaper. With these technologies in the batteries, is possible to store in a big scale energy for any use, and promoting the renewable energy.	Energy	Hard technology
3	The Blockchain	This is a big data decentralized where any electronic transaction is registered in a safe way and verified. Services and products like the Bitcoin are the	Financial services and Sharing information	Soft technology

	Technology name	Function and objective	Mainly used field	Type
		samples of the use of the blockchain as a digital money and it is forecasting the future of the finance sector in the world, where could be not necessary the intervention of a third actor in the chain of financial process.		
4	2D Materials	This is the revolution of the materials; with crystalline substances with a thickness of a few atoms or less, that makes more resistant and stronger materials. Some of them also can conduct electricity better than copper and are flexible because of the chemical process. This material can be used in any kind of product.	Construction and products	Hard technology
5	Autonomous Vehicles	Autonomous vehicles are being used more and more over the time, which mixes the use of several technologies as advanced batteries, sensor, and Wi-Fi that allows them to go through the ways without the need of a driver. One of the most benefits of this is the use of renewables energies and drivers can harness the commute time to make other activities.	Transportation	Hard technology
6	Organs-on-chips	These are micro models of organs of the human body whose can emulate the organ–level functions of the original organs.	Health	Hard technology
7	Perovskite Solar Cells	The solar panels with this new cells are much more efficient generating the energy, considering it as a trustful	Energy	Hard technology

	Technology name	Function and objective	Mainly used field	Type
		power source, harnessing the photovoltaic properties of this material allow get a cheap electricity from the sun with cheaper prices than the regular silicon, most used in nowadays in solar panel.		
8	Open AI Ecosystem	Artificial intelligence (IA), can interpret more and more sources of data as speech, text and the financial behavior and health condition for finally provide supporting services in everywhere. This ecosystem is becoming more used in simple activities as a personal assistant.	Information access	Soft technology
9	Optogenetic	With this technique, scientific can activate and deactivate specific neurons in the brain in a precise way. This control in the neurons open the door to solve many health problems in people with mental disorders and cure diseases as Parkinson and the epilepsy.	Health	Hard technology
10	Systems Metabolic Engineering	The pollution produced by the use of fossil fuels represents one of the biggest worries in nowadays, the reason why the innovation in how to make any kind of product with plants as not pollution resources instead of fossil resources, between are the building block chemical can be manufactured better, easily and in a cheaper way.	Biotechnology	Hard technology
11	Liquid biopsies	This technology is one of the most revolutionary and advanced technique	Health	Hard technolog

	Technology name	Function and objective	Mainly used field	Type
		in the fight against cancer and represents an alternative to make the biopsies when is not possible subtract tissues from the organs. With molecular biotechnologies machines, doctors can analyze in a micro level the blood of the patients and identify tracks of cancer in the blood thanks to the technologies that allow making analysis of the DNA.		y
12	Harvesting clean water from air	The implementation of technologies is overcoming the need for humid conditions and energy to extract water from the air. Now, thanks to a process of porous crystals, developed by MIT and California University, is possible convert the water without energy. In some cases, the required energy is replaced by solar panels too.	Water production	Hard technology
13	Deep learning for visual tasks	Use of smart devices and computers to recognize the shapes and forms of images is getting better than the capacity of the human being. Machines are using these skills to develop simple task such as drive autonomous vehicles, medical diagnostics, and control of water levels and performance of crops.	Information production and control	Soft technology
14	Liquid fuels from sunshine	The creation of a catalyzer who can are activated by the sunshine and can separate the molecules of water in	Energy production and	Hard technology

	Technology name	Function and objective	Mainly used field	Type
		water and hydrogen and this can be transformed in CO2 in hydrocarbons represents the opportunity to generate no fossil fuels, could represent a useful alternative for the solar and wind industries.	biotechnology	
15	The human cell atlas	Consider as one of the most important advances in the health field, the project called "Human Cells Atlas" is looking for identifying each type of cell in the tissues, getting information about genes, proteins and other components that are active in the process that controls the activity of each organ in the body. This project could allow advance more about the health care and cure diseases.	Health	Soft technology
16	Precision farming	This innovation is directly derived from the fourth industrial revolution, which is providing to the farmer's new tools that help to make more efficient the crops by the use of a more efficient way the required inputs at the same times that care the environment. The precision farming use sensors, robots, GPS and other tools like map data to care and monitor the evolution of the plants. However, it does not only incur inexpensive drones and programs, for example, there is a technique that also can register the information through the use of low-cost technologies based	Farming	Hard technology

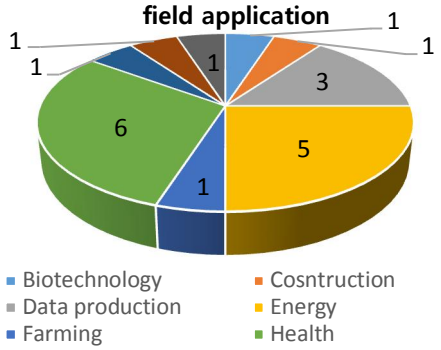
	Technology name	Function and objective	Mainly used field	Type
		on solar energy and smartphones.		
17	Affordable catalysts for green vehicles	Scientifics are searching about how to decrease the dependency of the cells fuels powered by hydrogen to the platinum, which is an expensive element and represents a barrier to the advance of these technologies.	Energy	Hard technology
18	Genomic vaccines	The new generation of vaccines offers advantages such as less time required making them and they are cheaper too. In addition, one of the most important advantages is that these vaccines they allow identifying a mutation in the body or resistant people to these vaccines.	Health	Hard technology
19	Sustainable design of communities	As the aggregation of several techniques, communities are being built based on instruments that can control the number of resources that they consume and getting closer the level to 0 carbon emissions. In this case, the technology is the design of the infrastructure which can re-use resources like water from toilets, wash machines or rainwater.	Urban development	Hard technology
20	Quantum computing	The capacity of computers is increasingly high and fast, reducing the time required making at the same time millions of process, which means that computers are more and smarter. Still, the price of this is high due to the huge investment required in the process of its construction.	Physic (Computing)	Hard technology

Source: Main information taken from World Economic Forum.

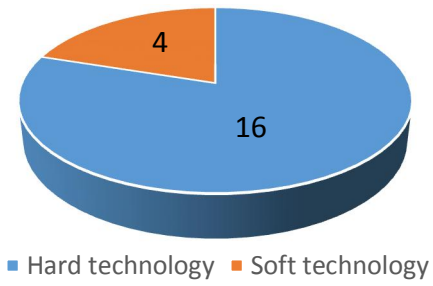
As is showed in in table 3, the 20 technologies are being implemented as strategic tools in several fields in a fast and high competitiveness, by using hard or soft technologies in each field and problem. Anyway, still is required the preparation of people or workers, in some cases no more than a repetitive process associated with the operation of the technologies, which can be done by people who received previous preparation.

In the case of hard technologies, the implementation of them would require the operation by people, which mean that its implementation, fulfilling certain conditions, can provide opportunities for labor, and generate employment in the communities. By another hand, the soft technologies, associated to the organization and management of the knowledge can be associated with facilitating the information or the way that they could share data or, what them self-generate as preferences or problematics among societies, what finally is considerate as an important product in nowadays, the data.

Graphic 8. No. of technologies by field application



Graphic 9. Type of technology



These soft technologies are implemented in several institutions to enhance the performance of the process in organizations or groups which have some common objectives. This point makes think about the communities like an organization or company more than just a trouble or burden for the State, which has skills, knowledge, and economic and social objectives that in a unit level (Family) can be relatively different but in a general level (Community), are similar.

The implementation of these technologies in the human being for improve the quality of life in social fields like health, production of energy, environment, transportation, farming and others, show us the need of think about the need of innovate in the use of them, keeping with the theory of the disruption of the technologies. These technologies in developing countries are not well considered like an option for solving social problems because the barriers of the first view like the expensive cost of them or in other cases, the limited access of the actors to understand the function of them and the real price. The barriers will be considered below as one of the filters to analyze the implementation of

social housing projects to solve social and economic problems among families and communities.

But the reality of these technologies seems to be totally different in some of them, where the innovation of production of some products or outputs required of knowledge and techniques to discover the new technology, and in some cases, there are not complex processes could be developed by people with certain basic level of capacitation.

At this level, technologies can show limited uses about the output or product but also show options about how to use these technologies to produce and harness these processes in the reduction of the cost or expenses associated to the social housing and the increase of the incomes of low-income families and communities. This could mean the opportunity to generate employment and techniques that been adopted by people without high-level education.

Thus, in some cases, the benefits are not in the final product what is the technology for, in some cases, the benefit can be in the process of production of these, where the families can access after the adjustment over on prices and techniques over the time of technologies and finally support social public policies.

The water and energy production are tied to basic goods, water and energy, that cities demand in every levels (since families to communities).

Services as health, biotechnologies, transportation, communication and computing, are fields that demand high specialization in its knowledge, and in some cases, the implementation them require high investments. For this reason, in a feasibility stage, the energy and water production would be the suitable technologies to analyze. It does not mean that other technologies do not represent opportunities in social housing, but the information and details of them, should be analyze with deeper knowledge aver them and housing issues.

6.3 Feasibility of price and usage of technologies

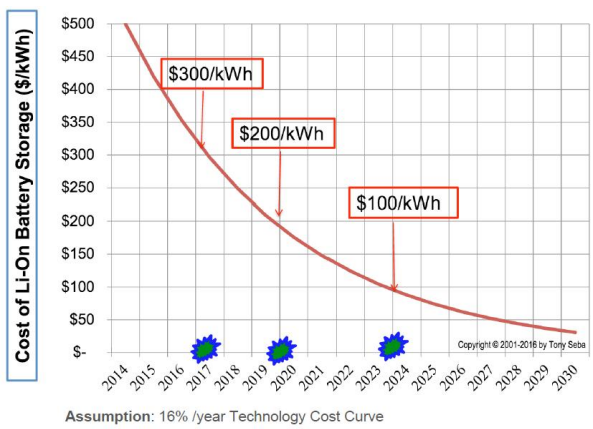
In order to get a sample of technology to be analyze in the framework of social housing projects, the prices of the technologies should present a significant decrease of its prices. This criteria works as a filter to develop the deductive analysis, considering that high prices of technologies could difficult its implementation because the high price in the technology could become the investment of the government as no-beneficial intervention what means a negative TIR.

Considering the theory of Tony Seba (2016), the disruption of the technologies in latest decays has made that price of themselves decrease exponentially over the time, especially in the energy technologies, which can produce energy in a lower price, reason why the production of energy field provide suitable technologies to analyze its implementation in social housing. According to the table no. 3, in total 3 technologies were selected as one of the most innovative technologies along 2016 and 2017 (Next

Generation Batteries, Perovskite Solar Cells, Affordable catalysts for green vehicles).

The prices of the solar panels decreased from $77 per watt to $0,64 per watt in 2016, sample of the continuous exponential in last 40 years, which fell 99,2% along this period . Even though the price of these technologies falls, there are utilities that can be harness with the structural industries change (McClatchy, W. 2010). This notion has not been understood as an opportunity in social housing policies, where the industry of the energy could be supported by the labor force of the low-income communities and the space and infrastructure provided to this people.

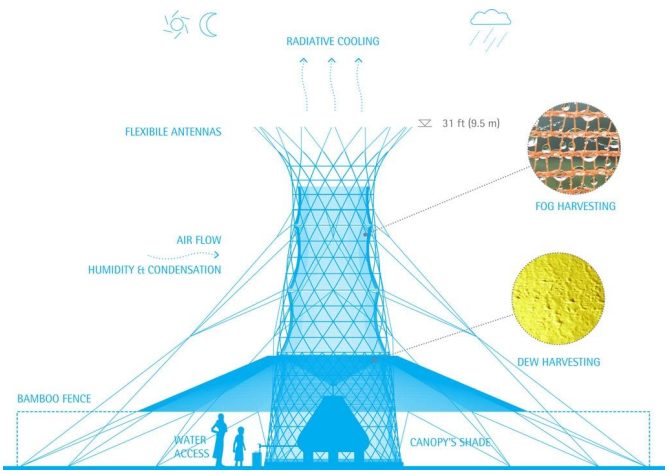
Graphic 10. Projected cost of Li-On Battery $/kWh



Source: Clean disruption, Tony Seba.

In this way, the technologies that produce photovoltaic energy fulfill the requirements of affordable prices and could be considered to be implemented as a strategy that increases incomes and reduces cost among low-income families and communities.

Another technology to consider according to its price is the technique "Harvesting clean water from air", which has several techniques. One of them is handmade and use common and affordable materials like plastic and bamboo. In addition, it has useful functioning for the community and city in general. Considering that this technology is recent, there are not enough data about its price, and in addition, the very high affordability represent no represent a barrier of costs be implemented in social housing projects. Even though, the production of the water is limited, having a reduced supply of the product (water) to commercialize with external actors to the project. According to its invertor (Vittori, A; 2015), the installation of this devices is mainly though in rural areas where the access to the water is limited and communities face difficulties, but the environment is suitable. Therefore, the area, where these technologies should be installed, does not have a flexible range, as roofs or public spaces.

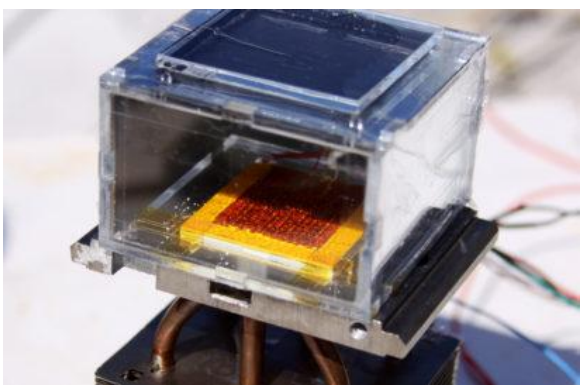


Resouce: www.dezeen.com

Figure 1. Warka water technology model. Harvesting water from the air.

Another technology in the extraction of the water is the invented in the Berkeley University in San Francisco in 2017 is one of the most innovative

inventions of recent years due to its social impact to provide water to population (Sanders, R; 2017). This device, as the Vittori's device, harvest water from the air, overcoming limitations such us space where it can be installing and environment and weather conditions. Even though this device can collect 2,8 Lts. of potable water in 12 hours in all weather conditions and in small places, the limitation are in the price because the prices of the materials required by this device are still very high. By another hand, the industry for the production of this device has not yet developed enough, which is why it requires time to lower costs and achieve mass production.



Resouce: UC Berkely news.

Figure 2. Device pulls water from dry air, powered only by the sun.

Table 4. Matrix of technology analysis (Usage and price)

Name of technology	Possible Usages?	Applicable	Affordable technologies?	Applicable
Solar panels and next Generation Batteries (Energy storage)	The solar panel and the storage of energy represent the opportunity of developing remunerated activities selling energy, which could be complemented the solar panel as producer of the energy. Therefore, the	Yes	The energy storage is one of the most representative samples of the disruption and exponential behavior model in prices. According to the Electric Power Research Institute (2015), lithium-ion	Yes

Name of technology	Possible Usages?	Applicable	Affordable technologies?	Applicable
	product could be the energy but there is required an especial structure to organize the community around the business. Activities associated with the installation, maintenance and correct functioning demand labor force that can be supplied by the community. The advance in the batteries of storage of energy, the results in batteries of carbon are encouraging for the near future, because their capacity and duration are much greater than those of a few years ago.		batteries drop 15% per doubling the volume, thanks to the innovation in its production and its application, following the same behavior of the solar panel and the disruption model mentioned by Tony Seba (2016), which allows its implementation more affordable.	
Harvesting clean water from air (water production)	The water as essential resource resources in the human life always will be demanded. Water as a final product of the technique "Harvesting clean water from air" requires techniques of the specialized labor force in the installing process but its operation and maintenance require simple capacitation. In other cases, like in Vitory's device, it does not require deep knowledge for its installation. In the same	Yes	Because this technology is recent, there is not data on the behaviors of the prices. In the case of the technology of Arturo Vitori, the materials required by the device are affordable for low-income people and the labor force does not require special knowledge that increases its price. In the case of the device developed by the professor Omar Yaghi,	**No**

Name of technology	Possible Usages?	Applicable	Affordable technologies?	Applicable
	way, the final product (water) offer the option of creating a business. In any case, there are several techniques to harvest the water from the air whose varies the price.		the prices are not affordable to low-income people and its industry is not enough developed.	

As result, the production of energy through solar panels is the technique that has a favorable feasibility to be implemented in social housing projects according to the conditions of the price and useful usage among the community.

7. Technologies in social housing

One of the reasons why the technologies are not well known in social housing is because the concept of technology in infrastructure is clearly associated with corporate projects or other uses such as public spaces, public institutions or industry (Pardo, J. 2016), different to housing and especially social housing. By other hand, housing and technologies only present convergence in the reduction of the cost along the process of building this type of infrastructure and the use of advanced materials in its construction.

These two points mentioned above are the result of public policies oriented to encourage and preserve a sustainable environment, mixed with

the necessity of provide sustainable infrastructure. The Colombian case show clearly a slanted implementation of the model of sustainable infrastructure. The public policy of sustainable infrastructure in Colombia considers the sustainable development framed in the inclusion of three fundamental elements: The public policy of sustainable infrastructure in Colombia considers the sustainable development based on the inclusion of three fundamental elements: a. economic sustainability; b. environmental sustainability; and c. social sustainability (CONPES 3919, 2018)[2].

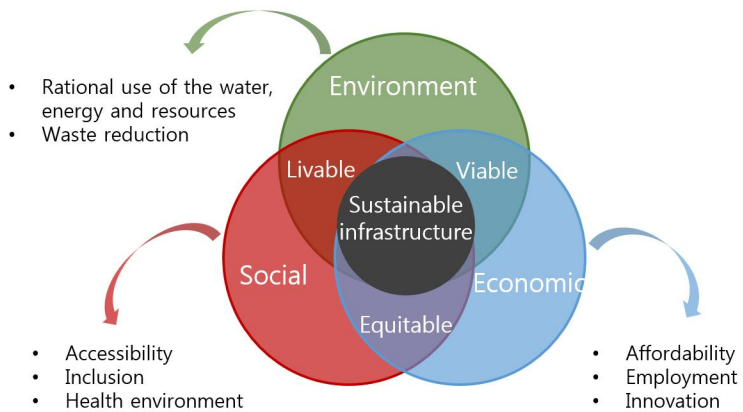


Figure 2. Dimension of sustainable infrastructure.

Source: DNP-Conpes 3919, 2018

Nevertheless, the economic component has not been encouraged in the economic dimension and its three sub dimensions: Affordability, employee and innovation. For this, is necessary to check some of the social housing projects that have been considered as a sustainable infrastructure and after ask to the Housing Ministry of Colombia (Department Housing System of housing Ministry, 2018).

[2] CONPES: The National Council of Economic and Social Policy of Colombia.

The Ministry of Housing and City and Territory (MVCT) and the National Department Planning (DNP), were asked about the main technologies implemented in social housing as components implemented as a tool for making sustainable the economies of poor people. The result was a list of technologies implemented in social housing, installed as a pilot project to save the consumption of energy and water principally. The results were satisfactory because, in some of them, they could save energy until 88% of the consumption per month.

This pilot project, called "Financing model for sustainable housing in Colombia" was based in the model of the Sustainable and financeable social housing in Mexico, developed by the institution of financial social housing from Mexico (INFONAVIT). This project provided green technologies as an additional component to the social housing, the beneficiaries could financial the housing improving the cash flow thanks to the new low cost of the public services, at the moment of save energy and water with green technologies.

Table 5. Technologies implemented in social housing projects-Colombia

Item	Measure	Technology	Measure
Toilet	6 Lts	Efficeint toilet	4,8 Lts
Hand washing faucet	10 Lts	Saver faucet	5,7 Lts
Shower	10 Lts	Saver shower	7,5 Lts
Kitchen faucet	10 Lts	saver faucet shower	7,5 Lts
Washing machine	220 Lts	Efficient washing machine	80 Lts
Electric shower	3500 W	Solar heater	150 Lts
Incandecents bulbs	40, 60 and 100 W	LFC or LEDS bulbs	Led 5;7;8;9;10

Item	Measure	Technology	Measure
Fridge	9-11 ft/60-70 Kwh/month	Efficiente fridge	35-40 Kwh/month
Air conditioner	1.5 Ton /60 - 70 KWh/month	Minisplit air conditioner	2 ton/1680 W
Gas heater	6 Lts	Solar heater	150Lts

Source: DNP, GTZ and MVCT, 2016.

Thus, although government and developers have been interested in the implementation of technologies, in these case called as green technologies in social housing, these measures have been focused to impact the consumption of families in social housing and adapt the infrastructure in low-income families to the protection of the environment. For this reason, the implementation of these technologies can be understood as limited considering other possible positive impacts and the option of generating income through them.

As a pilot project to recognize the amount of energy that green technologies could save in social housing, were installed green technologies in projects located in each kind of weather (Cold weather, temperate climate, dry warm climate, and warm humid weather). Energy savers were installed to measure the reduction of the cost of the energy and water in social housing.

The reduction of 11% of the energy consumption and 15% in water in average, show weak benefits for the reduction of the cost of public services in low-income families. Even though any reduction in the cost of the public services would improve the economy of these families, the impact of the reduction is consider as of low impact.

Table 4. Savings of water and energy in social housing projects

Wheater	Percentage of saving achieved (2016)	Average Public service price (USD)	USD saved with green technologies
	Energy		
Cold weather	8	5	0,40
Temperate climate	14	8	1,10
Dry warm climate	2	11	0,21
Warm humid weather	20	2	0,43
Average	11	6	0,71
	Water		
Cold weather	7	6	0,42
Temperate climate	18	7	1,26
Dry warm climate	22	4	0,93
Warm humid weather	11	5	0,55
Average	**15**	**6**	0,81

Source: Own calculation with data from "Final inform of pilot project for saving in social housing projects" DNP-2016.

The data obtained by this pilot project also showed that in some cases, the saving achieved 25% of saving (water) and 33% of saving (energy). Asking to the consultant of the study about the reason why certain housing got higher level of saving, they answered, "*The reason is because in some of the social housing we could implement*

key devices as water heater, which is more expensive but at the same time helps to achieve a higher level of saving. A second component was a cultural factor, because they made use of these technologies properly and in other cases they do not do it" (Consultant of the project pilot in social housing for DNP, GIZ and Germany Cooperation Agency, 2018).

The implementation of technologies in social housing seems to be no only an economical issue; it also is linked up to cultural factor that could be consider as intangible factor to manage among communities. In this case, the success of the pilot project also depends about how the program or strategic can control the use of technologies by communities, which is tied to the creation of structures of power that control the use and make the maintenance of this over the time.

7.1 Considerations about the price of social housing in Colombia for the implementation of technologies

The provision of social housing, supported by the governmental programs is addressed only to families that do not have incomes that overcome the 4 minimum legal wages of Colombia (1.1160USD in 2018). In the same way, the government limited the price of the social housing, which cannot overcome the 135 minimum legal wages (37.667USD, in 2018). In any case, the housing could not overcome this price or would not be considered as social housing and the government do not provide any kind of subsidy or aid to facilitate the access and affordability in low-income families.

Thus, to be considered as a social project, the prices of each housing cannot overcomes the maximums stablished by law. Then, technologies should be considered no like an additional cost of the housing, conversely,

it should be facilitate through a financial system over the time that provide the technology and make sure about the correct functioning in economic and social aspects. This limitation requires a special scheme to match the usage of technologies, economic and social objectives.

7.2 Case studies: How developed and underdevelopment countries tackle the implementation of solar panels in a social and economic framework

One of the phenomena generated by the wave of the technologies is that these allow the communities work around these, thanks to the interest generated by the benefits of these and the human condition to evolve through the innovation. In addition, if technologies are allocated in the frequented places as entertainment places, public spaces or housing, people adopt it easily when they start to familiarize and understand more about its functioning and benefits. One of these examples is how communities are using certain suitable spaces in housing as roofs, in order to the production of solar energy. The usage of solar panels has created what is called "community solar projects"

"A community solar project—sometimes referred to as a solar garden or shared renewable energy plant—is a solar power plant whose electricity is shared by more than one household. (Energysage, 2018)"

Bronte City, Italy:

Due to the deterioration and obsolete infrastructure of most of the social housing in Italy, the low-income people represented a population that registered high levels of consumption of energy and other basic services as water (Gaggliano, A. Nocera, F. Patania, F. and Capizzi, G. 2013). As a sample measure, the government decided to implement technologies in order to two goals: Reduce the consumption among the social project in Bronte City, and increase the comfort level among the low-income families.

The government installed technologies such as centrally solar heating system, rainwater harvesting system and the photovoltaic solar system. After this, the social housing project achieved change key components to be amended it improve the energy behavior, saving energy and other services that represent a financial burden for those families. Even though the implementation of the technologies was not thought specifically to improve the economic condition of the low-income families, the economic effect on the families was outstanding. This project, with only 54 units, worked as a reference for the Italian government of Italy to replicate this model in a large scale, reducing the energy consumption, increasing the comfortability of social housing and low-income people and keep searching for further technologies in social housing in order to solve the problems around this population.

Jiangsu, China:

In Jiangsu, China, town of Quinghu, were installed solar panels that are used by 129 families. The capacity of the installation is 381 kW, and the community only uses the 80% of this, and the rest of the energy (20%) is transferred to the public electric net. In this way, Jingsu has developed a mainful structure for the photovoltaic power generation in his region, since a centralized model of the government. This model incorporate a vision of the government to encourage and support the construction of large-scale photovoltaic power generation infrastructure for industrial enterprises and industrial park zones where land prices are higher (China Pavilion, Expo Astana 2017). Most of the generation of this energy is through the usage of variety of roof resources that makes sustainable communities in urban areas but that also generate a surplus of energy that connected to one grid, can reach industries whose demand high amounts of energy.

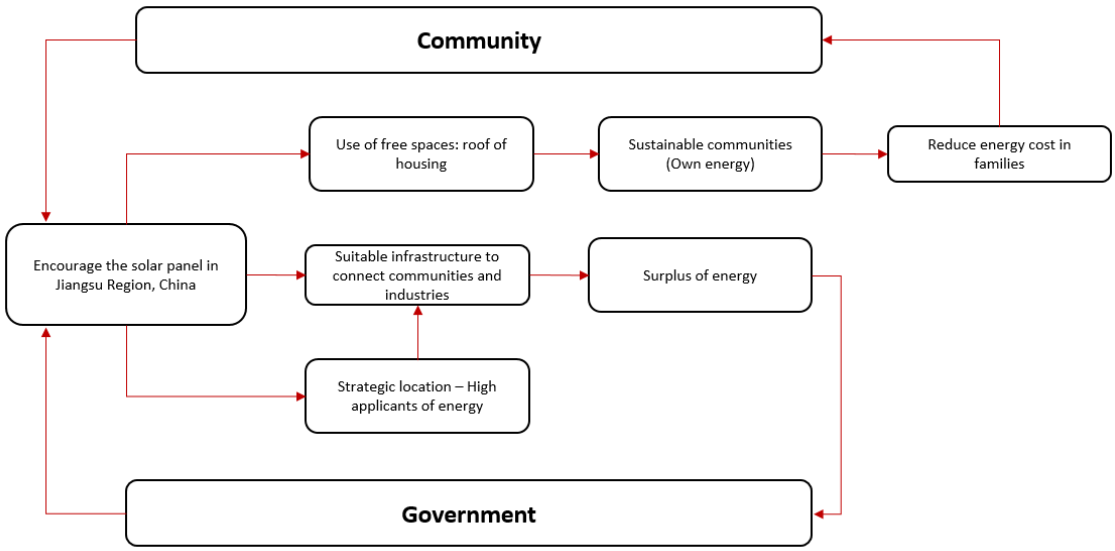


Diagram 3. Model of solar panel in housing project with energy surplus

The project is mainly though in two components: a. keep the process of changing the use of fossil resources in the generation of the energy and; b. Support the sustainable functioning of sectors, such as commerce, residential, hospitals and industries.

But in the Jiangsu case, there is not a clear measure that impact the use of these technologies in a positive way to low-income families, because there is not a social-economic component that allow to the householders get a receive the benefit from the surplus of the production of solar energy.

This project is considered as the most important photovoltaic energy producer in the eastern region of China, and the 5th along of this country

doubt to the got an increase its capacity from 1.23 million kW to 5.6 million kW (China Pavilion, Expo Astana 2017).

Mexico, Green Mortgage: financing Green technologies in low-income families

Through the governmental entity INFONAVIT, who is the main funder of social housing for low-income people in Mexico, the government look at the solar panels as an individual project among low-income families. INFONAVIT has the role of facilitate the access to the easy mortgages (tied to the housing public policy), to access to the green technologies with two main goals: a. reduce the cost of the energy in families and solve economic issues and; b. make sustainable families after the finish the credit.

The programs consider a saving score of the families whose have been following a process observed by the government, fix rules that low-incomes must fulfill and, stablish the structure of the programs to ensure the monthly payment of the families with the savings generated by the technologies.

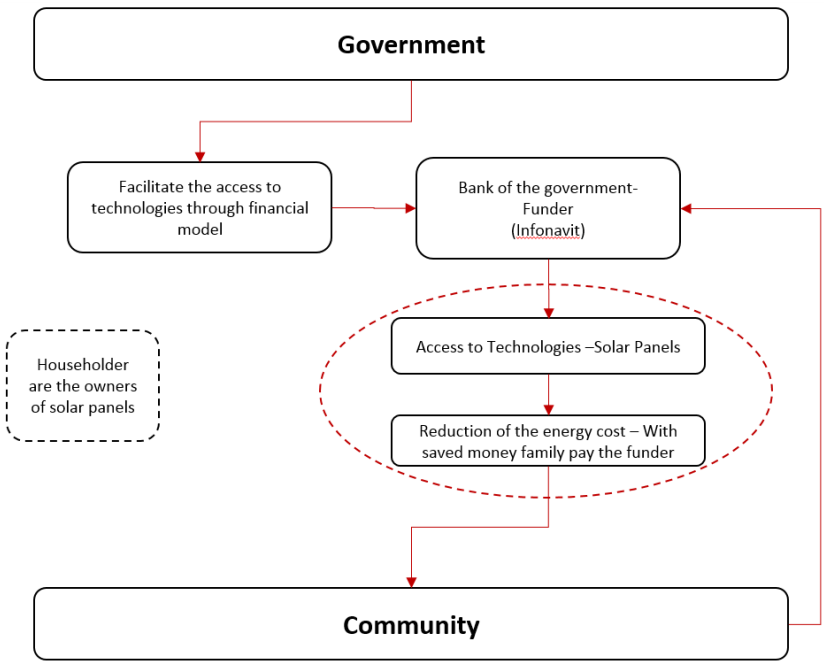


Diagram 4. Model of Social Green Mortgage in Mexico

In the case of the Mexican Program, a social component address all the effort of the program to improve the social conditions of low-income people. Even though, the program does not incorporate a component that allows increase the income of the families in a sustainable way doubt to the focus of the government on the technology which is considered just like a tool that help to reduce cost and with the reduction of the expenses, low-income families can redistribute the incomes.

This is an example of how governments have adopted the technologies among social issues, limiting its usage in the generation of the incomes after the reduction of expenses. It can be explained by the lack of one strong gear that converge several components such as housing,

technologies, social and knowledge barriers form the communities, anti-social behavior barriers and essentially the need of one external structure that provide a business base on the usage of the technologies to the communities.

8. Deductive analysis and feasibility: matching the social housing needs with use of the technologies

Considering the critical problems of low-income families at the moment develop a new life informal housing, the incomes represent the key component to guaranty the success of the communities and each family. There is a clear reason why the green technologies have been considered as the strategic component to improve the conditions of the families. Although, the innovation about how communities use these technologies has been limited.

As was mentioned before, the technologies are the inputs that will produce an effect on societies and people. This idea make us to think about the need of keep introducing the closeness of technology with communities in now days, in order to provide suitable tools in one world who use technologies in every fields: communication, economies, entertainment, transport, health, education, and now, thinking about how this should affect the center of the housing.

8.1 Social housing and technologies: Matching point (Use and price).

Consideration around of the industry and requirements from the production, installation, implementation and maintenance of these technologies are crucial to understand in their chain life the flexible points where the common people, communities and families, can involve in the process for get economic benefits but with some view about the social benefits.

In addition, is important to explore technologies that can be implemented on the performance of the housing and the skills of the communities that increase the incomes and reduce the cost associated with the housing, until the time that families can consolidate in the formal economies. In any case, the exploration over this technologies also make think about some schemes of the production of innovation that also should be consider as an option for encourage the positive growth among this population.

According to the results of the deduction developed in the chapter of housing, the families require increase incomes due to the impossibility to link up to the formal economies that at the same time provide high or suitable incomes. The burden generated by the new expenditures of the formal housing, without a formal economy, families cannot be sustainable over the time, talking in economic terms.

This approach makes conclude that the provision of social housing, although it is totally subsidized, is not going to change the economic conditions of families, reason why in a short future, the social housing project get negative impacts due to families have to return to informal

dynamics. In cases when beneficiary families go back to previous informal housing it also entail an additional cost associated with selection of new families and the cost of opportunity of empty housing when the government runs the legal process to allocate the housing to the new family.

In this way, involve to families in the social housing project, understood not only like the infrastructure but also like the creation of new families, should bring additional components where families could converge among the creation of new social capital and the creation of new formal economies. As a massive production of the infrastructure, social housing projects, and the aggrupation of people should be understood as a positive opportunity to think the allocation of people like a productive unites and develop new positive process in social and economic components. This, more than an additional burden represents an opportunity for low scales economies fitted to low-incomes people.

Thus, the implementation of projects cannot be determinate by physical components as the provision of infrastructure, it also should consider how people would develop new economic and social activities, what, thinking in terms of technologies, should fulfill:

1. Technologies with a simple process of its usage: Chance of harness the process required get the final product. As low-income communities do not have high education level the labor force is limited, the reason why is required a simple process that does not require special knowledge or specialties. The production of goods by the inclusion of low-income communities to the formal

economies, contributing to the reduction of the inequalities and poverty circles formed in the deep poverty, generating incomes and employment (Development Bank of Latin America, 2013). The creation of common objective in communities encourages the creation of social cohesion.

2. Technologies that produce outcomes easily tradeable: creation of useful products generate profitability that could be harness by communities**.** Think about make a "companies leaded by communities could be not logical, especially when the organization of these communities at the beginning of the business could bring interest conflicts among fellows of the community.

Considering the techniques and technologies listed up by The Word Economic Forum (2016 and 2017), the water and energy as a basic resources are the components that define the kind of technologies. The energy, provided by solar panels and the news techniques to collect the water, are technologies that could be executed by not specialized labor force.

Thinking about productive housing units:

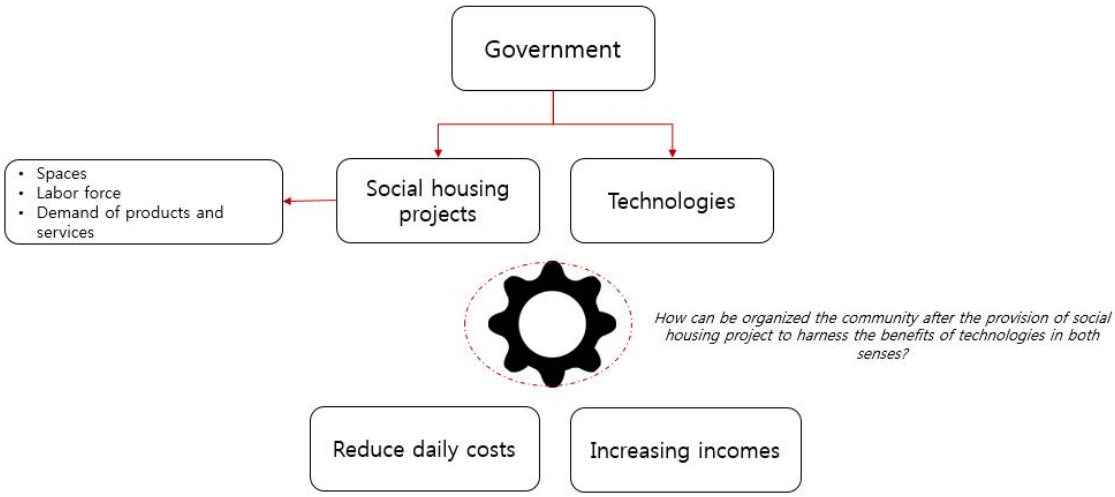


Diagram 5. Suitable model to harness technologies-Social housing projects and technologies

Thus, the match point between technologies and social housing is develop by the skills of the community and each family to develop activities regarded with technologies, not only making the use of the final process but also understanding and adopting the whole process of them in order to subtract benefits that production process can offer.

The point where the social housing projects, provided by government can match with technologies would be defined by two main components, thinking in terms of the housing and community:

1. Price of the technology does not affect the price of the housing, which could make it less affordable for low-income families. In the

case of the Colombian government, the social housing projects are totally subsidized and the law established the maximum price of the social housing.

2. The use of the technologies, as a strategy for improving the economic conditions of low-income families through the provision of social housing, should play a role in a framework defined by the government and the beneficiaries. However, it also should include a third actor who will implement the scheme and it should make the actors within the scheme fulfill their functions and likewise ensure compliance with the goals established within the community.

8.2 Social housing in a massive production requires massive quantity of solar panels:

In 2014, produce 1 watt of energy solar was 70 cents of USD, which means that the production of 150 watts was around 103USD. In Colombia, to buy less than 10 solar panels increase the price, and added that there is not a massive use of these devices, the market of solar panels can not provide competitive prices (Martinez, Juan. 2015).

Thus, the price per watt in Colombia is 1,3 USD if one family wants to buy solar panels of 200 watts, in a lower amount of units. It means that on average, each solar panel would be around 260USD. According to one research developed by BP Energy Survey (2012), revealed that although the significant reduction of the solar panel prices around the world, these are only supplying the energy of 0,2% of all world energy demanded. This low

percentage can be explained because the prices reach lower levels when the amount demanded is huge.

Therefore, the scheme of the social housing projects in Colombia produced in a massive way, overcomes one of the main barriers of the market of the solar panels. Considering that the government developed housing projects of 4.000 apartments (each build is not higher than 5 floors), most of these social housing projects count with suitable and enough spaces to install not only in the roof the solar panel, also in common areas, parking and others.

8.3 Cost of installation of the solar panels as a barrier

Most of the companies that offer solar panels include as a reference of the product that the devices are easily installable, and it can be done by the householder with a short capacitation. This is because companies want to overcome the barriers of the high price of the labor force for install the complete system.

In Colombia, in average, the installation of one solar panel system for one household that consumes around 120 kWh per month, cost 2.400USD if is included a batteries, investors and cables, without the maintenance, reason why it should be unaffordable, special for low-income families. This point is a sample of the implementation of technologies can not be an additional burden for beneficiaries, reason why is necessary think about other actor

that invest in this technologies over one scheme that involve and benefit the low-income families.

If one medium-high incomes family who pays monthly 24USD by the energy service decide to install solar panels to reduce the cost of the energy, it will recover the investment 8 years later, due to the high prices of the technologies generated by individual acquisitions and because there are not huge energy consumption of energy by the family. Therefore, individual solar panels would not be a sustainable measure in low-income people considering the level incomes and energy level consumption, which is lower than medium classes. This is the reason why invest in a solar panel is rentable for high demander of energy like industries or commerce and why this market could not reach residential targets.

Think about individual investments, the use of technologies like solar panels would be limited just to reduce the cost of the energy, without mention the positive impacts on environment, but there are not considered the outcome produced by the technology, in this case the energy, which in cases when the consumption is lower than the production, the surplus of energy could not be commercialized.

By other hand, the barriers can be understood as an opportunity to take advantage, due to the installation of them don't require a capacitation of complex process, what could be done by same community, generating qualified labor force.

8.4 Finding key aspects of the infrastructure to adopt technologies: Social housing in height

Since 70's years, Colombia experiences the construction of social housing in height because of two main reasons: a. To get a rational use of land in a model of compact cities and; b. the economic rationality of developers to get cheaper housing in mass (Ballén, A. 2009).

This fact in the model of the production of social housing has restricted the access to technologies that can be installed to the housing, because the low-income families that would like to make use of the solar panel, for example, are not allowed to make it because legal restriction to preserve the order among the infrastructure. Thus, only one person, in the case that can access to solar panels, cannot make use of this and, instead of this, require the approval of the rest of the owners in the social housing project. This explain why there is not a strong market of solar energy on residential areas, especially when the average of the last 10 years in Colombia, the 40% of the production of housing is social housing (Camacol, 2018).

For this reason, the initiative of install additional Infrastructure, or like in this case, technologies, should be made in one framework that involves all the community and that can provide uniformity and equity at the moment of receiving the benefits from the technology.

In this case, talk about a match point between social housing projects and solar panels as example of technologies, is possible, thanks to the requirement of the market to decrease more the price of panel solar through wholesales.

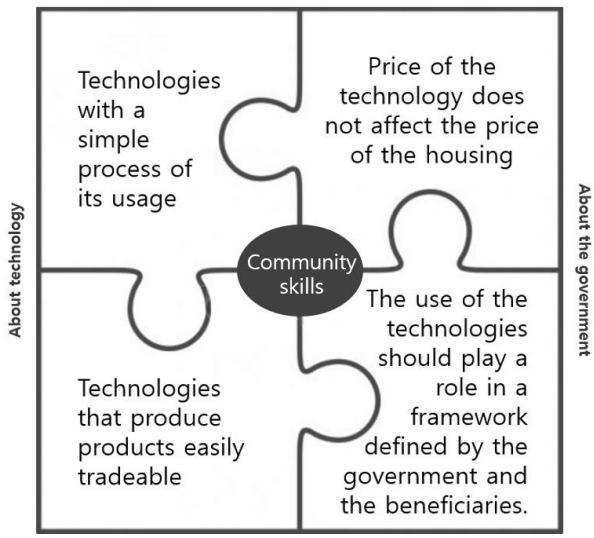


Diagram 6. Consideration over the technologies in social housing projects

8.5 Suitable schemes and structure model for the implementation of the technologies:

As was mentioned before, the social housing policy in Colombia is based on the subsidy to the demand (low-income people who cannot reach enough level of incomes to afford a formal housing).

As was mentioned before, the social housing policy in Colombia is based on the subsidy to the demand (low-income people who cannot reach enough level of incomes to afford a formal housing). If the poor family fulfill the legal requirements such as: do not have another dwelling, not having received a housing subsidy previously, do not overcome certain incomes level and in the case of the displaced people, prove the condition

of displaced by one official entity, they will be beneficiary of the program of social housing with one of the social housing. In this case, the housing is totally paid by the government.

Is also important to mention that the government developed a scheme where the private sector is the responsible of build with the conditions established by the same government. The requirements are related to the legality of the location of the project, which must be incorporated in the plan of the land order of the municipality and physical requirements of the projects, such as a minimum area of 45 M^2, and the use of endorsed materials by national competent entities.

Therefore, in order to recognize the positive impact of technologies in social housing programs and low-income people, is necessary to analyze 3 stages, since the provision of the housing, understanding the framework of the social housing programs to incorporate in a suitable way the use of technologies to provide positive impact in social and economy components.

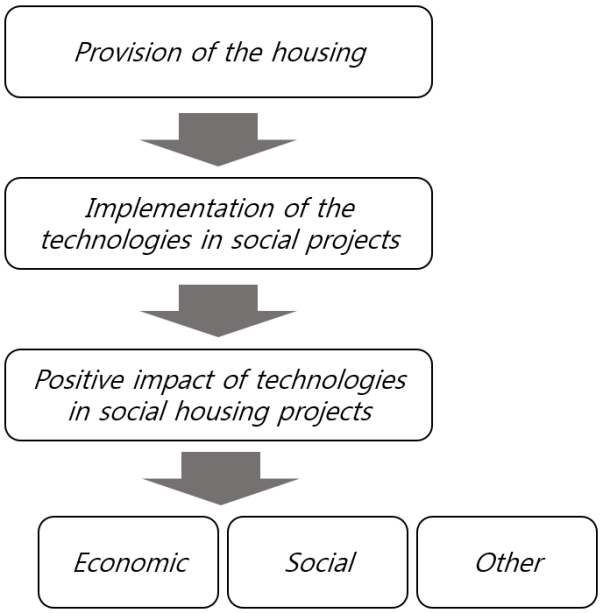


Diagram 7. A deductive process of implement technologies in order to get positive impacts from technologies.

8.6 Common points of technologies and the provision of the social housing through social housing projects

The access to the housing by low-income people through the social housing project define advantages to the technology such as the size of the community and the opportunity to connect external markets that demand products and services generated by the community with technologies. The location represents a critical decision due to it can harness external and internal advantages.

If the project is located in a strategic place near to industries, commerce or logistic areas, for example, it could facilitate the access to local or regional markets where the product produced by the community with technologies could be easily tradeable. This means that at the moment of conceiving the social housing program, there should be included in the feasibility stage criteria of closeness according to the technology that will be implemented in the social housing project.

In addition, the internal opportunities are those regarded to sell and buy the products inner the same community and social housing projects. According to the Vice-presidency of the Republic of Colombia (2016), in all social housing projects visited in the framework of the strategy of the complementation of free social housing program with additional social infrastructure[3], communities started own business in informal ways, all of this related with retail of food, water and in some cases services as laundry and children care. Even though the urbanism of the infrastructure was not arranged to this kind of business and social housing projects did not provide suitable commercial spaces to develop this kind of commerce, community adjusted apartments to develop them.

If there is a suitable planning process to supply this kind of spaces for retail establishments, the commerce who is a significant consumer of energy,

[3] According to the Vice-presidency of Colombia who led the strategy to provide social infrastructure to new communities such as schools, public parks, and children care along 2015 and 2016.

could be encouraged from the residential sector which clearly has a key role in the daily dynamic and economies among low-income people.

Therefore, the inclusion of commerce in social housing projects will generate 2 positive impacts on the communities:

1. By itself, the commerce fulfills his own purpose providing products and services. However, without solar energy (as a product of the implementation of technologies in social housing projects), increase the cost of his economic activity and therefore of his products which also impact families around because it is included as a fixed cost of the business. Providing energy by solar panels from the project can reduce the cost of products that low-income families daily buy. In the case that productive units inner the social housing project reduce fixed costs the marginal decrease will not be reflected in the reduction of the price of the product, instead of this, it will be reflected in higher incomes. It

Figure 3. Adequacy of social housing as a commercial establishment.

n Cucuta, Colombia, 2016.

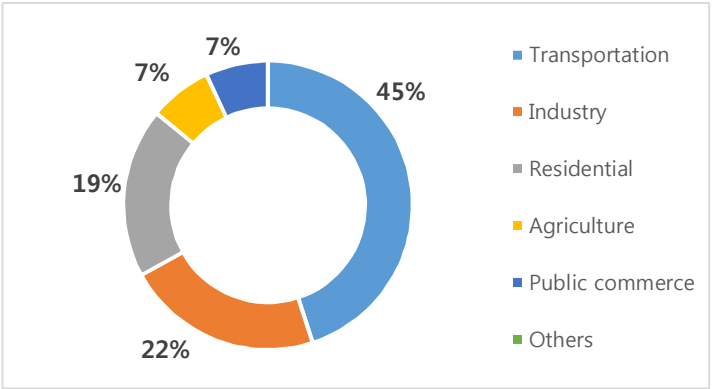
Social housing project in Cucuta, Colombia, 2016.

allows to save incomes in a higher level which at the same time represents a higher opportunity of improve the business or in the case of the low-income families, supply in a better way all their needs (Echeverria, S. 1993).

2. The inclusion basic and needed activities in the social housing project increase the demand for energy from inside, what at the same time guaranteeing the sale of the product and supports the development of formal economies. Then, the inclusion of technologies in social projects also help to reduce additional costs of low-income families, from different components not only from the saving consumption of energy in the housing but since the consumption of other goods.

In Colombia, the residential sector is the third consumer of energy, after transportation and industry. The public commerce located in 4th place; also represent an opportunity to connect the provision of energy produced in social housing.

Graphic 11. Domestic consumption by sector in 2012



Source: Energy Charter "Energy investment report in Colombia", 2016.

According to the Observatory of the Quality of Housing of the Andes University of Colombia (2015), in 726 social housing projects whose were evaluated the quality of the projects through several indicators in three levels: first, the quality of the unit (Housing); second, the quality of the projects and third, its connection to the city. The quality of the housing projects presented the lowest index in the quality of the projects, mainly explained by the indicators quality of the activities developed in the first floors, the design of the project and the inefficient usage of the resources

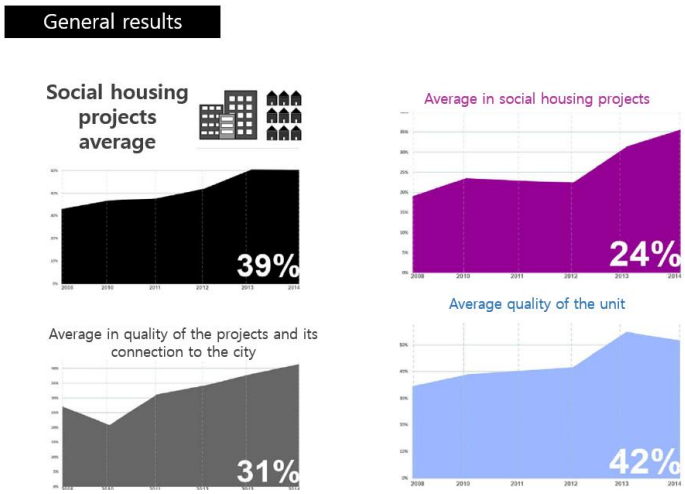


Figure 4. Quality of the social housing project 2010-2015

Resource: Observatory of the Quality of Housing of the Andes University of Colombia (2015)

Although the inclusion of commercial infrastructure in the design of housing projects as a supplier of formal commerce is currently being debated in Colombia, the virtues that this component has in the framework of the implementation of solar panels are not well known, as an example of the implementation of technologies to achieve economic sustainability in low-income households. Finally, these are strategies that allow us to break with the circles of poverty that arise thanks to the model of housing policy in Colombia (Construction of massive social housing for poor households).

8.7 Production of energy by social housing projects

Considering the physical characteristics of the housing projects whose have apartments of 50m² average, the ceilings of each building has a potential space for install the solar panels. In this way, the average area of the ceiling per each building is around 210m², considering the communal areas of the building stairs and halls (Colombian Ministry of Housing, Free Social Housing Program, 2015).

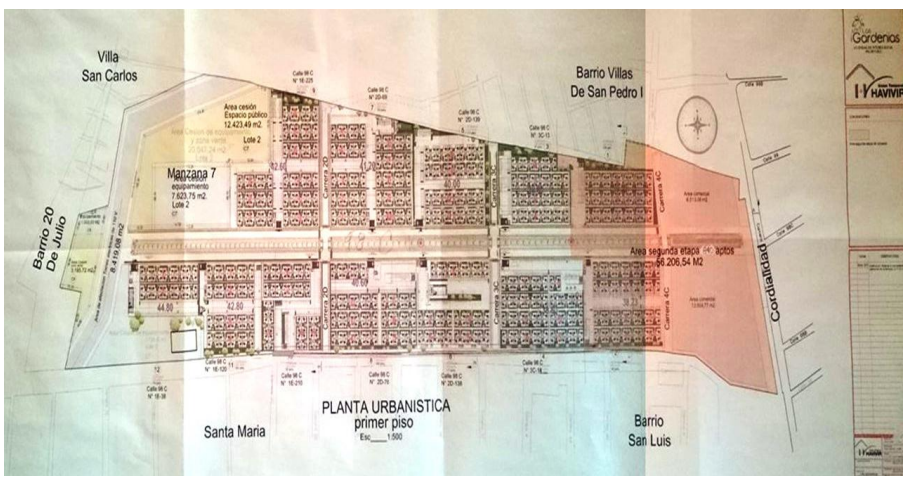


Figure 5. Plan of social housing project type in Colombia. Source: Barranquilla City Hall, Colombia. Social housing project in Barranquilla, Colombia. Villas de San Pablo with 4.080 apartments.

Thus, per building there is an average of 190m² available to install solar panels in social housing projects. According to the company GLOBALEM (2015)[4], the available solar panel in Colombia can reach 150wts/m² and as

[4] GLOBALEN company is one of companies in Colombia who has installed more than 10 MW around the world, advising photovoltaic projects in Latin America.

average, the sunlight per day is between 4 and 6 hours per day along the main regions of the country (Mining and Energy Unit Planning-UPME, 2017). For our case, we will use the national average of hours of sun per day (5 hours), what does not mean that at the moment of plan the project, is not important to consider the precise number of hours of sun that the location of the project has. Also is important to mention that in Colombia, there are not seasons and the weather has small variations.

Table 6. Potential installation of solar panels in ceilings of social housing projects

Item	Unit
Average of apartments per building (Units)	20
Available area in the ceiling of each building (m^2)	190
Consumption of energy per family (kwts/month)	140
Average of energy consumption per building	2.800
Energy produced per solar panels (wts/m^2)	150
Potential production of energy per ceiling (kwts/month)	4.275
Potential energy surplus per building (kwts/month)	1.475

In the case of the projects Villas de San Pablo, it has 204 buildings that represent a potential area of 38.760m^2, which would have a potential production of energy of 872.100 Kwts per month, and considering the average energy consumption of the 4.080 families (140Kwts/month), the project could get a potential energy surplus of 300.900Kwts/mth. This could be commercialized into the project and with external buyers as a buss=ness developed with the community to increase their incomes.

Table 7. Potential production of energy by solar panels

Item	Unit
Total area (m2)	38.760
Total potential production of energy-Villas de San Pablo (Kwts/mth)	872.100
Energy per project -Villas de San Pablo (Kwts/mth)	300.900

There is a significant potential of energy that the social housing project could produce with the implementation of solar panel as an examples of technology. The product of the implementation of the technology in one arranged scheme not only benefit reducing cost of the housing among the community and low-income families, also can be used to generate incomes after developing works along the process of the implementation of the technology.

Therefore, the scheme implemented among the housing project should link up the community (Each family) and the benefits generated by the implementation of the technologies whose are divided in the use of them and the final product by the use of them.

For the case of the solar panel and production of photovoltaic energy, the producers are stimulated by the law. The energy sector offer opportunities and incentive for the use of them (Law 1715/2014) to natural or legal person. The benefits are:

- Reduction of the income tax. In this case, is not applicable for the low-income families because the income levels, normally, do not get the minimum level for pay this tax according to the law. However, by other hand, the investor in this kind of projects could be benefited, reason why the legal framework in Colombia would favor the implementation of this sort of technologies.
- The generators of renewable energy in small and large scale could sell the energy surplus that is not consummated to the electrical network, according to the dispositions of the competent authorities.
- The national or imported equipment, elements, machinery and services that are destined to the pre-investment, investment, measurement and evaluation of the FNCE will be excluded from the value-added tax.
- Exemption from the payment of customs duties in: machinery, equipment, materials and supplies that are not produced by the industry national and its only means of acquisition is subject to importation, it must be requested to the DIAN, 15 working days before import.
- Accelerated depreciation rate less than or equal to 20% as the annual global rate.

The incentive of the use of renewable energy in Colombia are clear, but they are mainly focused to the investors whose have big amounts of capital to develop the investment in this kind of projects. However, at this point, the implementation of these kind of technologies could generate certain benefits to the low-income families through the reduction of taxes

that they cannot pay because the economic conditions. This measure should be consider by the government to link up in a stronger way to the communities because with proper implementation and use of the technologies as conditioning to the reductions of the taxes, will encourage the participation of community and the auto-control regarding to anti-social behavior.

8.8 Barriers and opportunities to implement the technologies

It is showing how could be the most important benefits of the implementation of technologies in social housing projects and the main barriers according to the analysis and deduction of the conditions of low-income families, social housing projects and how affordable are the new technologies. This is not a minor fact to consider at the moment of work on communities with a background marked by violence, gangs and crime regarding to the infrastructure, especially with use of technologies, because it could represent and interest to be robbed to commercialize it in black markets.

For this, is important to analyze the kind of tenure of the infrastructure by the families. According to one research develop in Andalucía, Spain, there is a relationship between the type of tenure and the speed of deterioration of the infrastructure (Pérez, Sáez and Trujillo; 2002), where the projects that were property of the families, presented better conditions of habitat, including general conditions of the infrastructure, while rent housing

presented worst conditions. This is closely tied to the conception individualism, characteristic of individualistic communities that care about their conditions and goods but do not care about goods of other.

The social housing projects in Colombia present antisocial behavior although the families are the owners of the housing. This can be explained mainly by the lack of opportunities in education or work that suffer these families as was mentioned before (ANSPE, Colombia; 2016). For this reason, is important to include in the management scheme of the technology, social components that improve the behavior among people and generate social capital and factors of resilience among the project.

The technologies can represent a component of interest for the community, when they mean the reduction of economic burdens and the generations of incomes and when the implementation of this, require team work; where each people have to interact with each other helping to the overcoming of differences and confrontations among them and the families for finally enhance the social-economic condition of the community.

8.9 Suitable schemes and structure model for the implementation of the technologies:

Considering that the schemes of the social housing programs in the Colombian case develop the projects with the support of the private sector,

which represents a contracting of the state to produce the houses according to the requirements and standards established by the government, the private ones participate in this investment until the moment of delivery to the beneficiaries. Therefore, the participation of private companies along with their financial capacity is limited from the design of the infrastructure, to the investment. the operation and maintenance is carried out by the beneficiary households, because at the time of the delivery of these dwellings, the government and the private dissociate themselves from the project, leaving these responsibilities in the hands of weak communities economically and socially.

The use of solar panels as a government strategy in overcoming poverty in these projects demands an extension of the participation of the state and the private sector with respective responsibilities. In this case, the technology would be the additional component to the infrastructure, which requires an operation and maintenance over the time. The social components and labor demands by the implementation of the technologies could be managed by the private sector, addressed to reach the objective of production, work, and social behavior.

One of these schemes that could be considered to get the operation and maintenance of the projects is the Public and Privates Partnerships, with the objective of reach private participation in order to provide public services and goods.

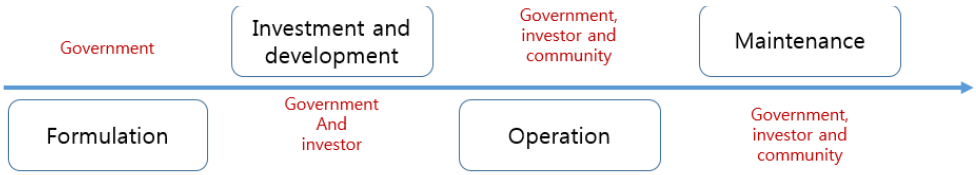


Diagram 8. Suitable participation of actors in the implementation of technologies.

In this way, the operation and maintenance could be guaranty working as a company or productive units where the communities and families can participate and get benefits from the activities developed with technologies in social housing projects. Anyway, the structuration of the project require deeper analysis, which should be develop at the moment of its implementation.

9. Conclusions and recommendations

Based on the theory of the affordability of social housing for low-income families, which require measures with sustainable and resilient notions, it is concluded that new technologies can affect positively the low-income people, being implemented as gear to promote sustainable economies that stabilize the transition of these families from informal to formal housing. Thus, technologies are the opportunity for governments to reduce risks associated to the change between informal settlements and formal settlements, as a measure to generate incomes, reduce cost among low-income families and create social capital in the new communities.

Even though, the social housing projects in high scale can generate a risks grouping vulnerable population with same social conditions, as the creation of poverty circles and anti-social behavior, this model also represents opportunities to harness the location of the project to another dynamics and markets and take advantage of the available force of the same community.

The public housing policy for low-income population must be focus in additional components more that the infrastructure, and the generation of tools that allow to each family and community make use of common skills to generated incomes and save resources as a strategy to overcome economic difficulties in a sustainable way. As a result of the analysis of the recent technologies, is concluded that these are addressed to solve human problems in several fields such as health, communication and provision of basic resources as water and energy and most of them still require of labor force with repetitive activities and process that no specialized people could learn and develop.

The new technologies can be analyzed according the process of its implementations (All the activities required make it work) and like a tool to produce some product like the energy in the case of the solar panel. Is in this point when the needs and difficulties of low-income people could make a match with new technologies in order to create social housing projects that work as a shelter and an economic engine of poverty communities. The model of the current housing programs and policies in underdevelopment countries contain characteristics that could maximize to solve economic problems among the low-income people and

contribute to the overcome of the poverty and extreme poverty through the investment of infrastructure.

The harnessing of the opportunities provided by the new technologies in the social housing framework should be though since the design of the infrastructure (Social housing projects). This means that the social housing projects should consider the sort of technology to implement, which in the case of the solar panels requires of economic activities that encourage the internal dynamics among the community and strategic location to facilitate the linking up of the internal activities of the projects with external markets to take an active role in the city.

Technologies are the result of a modern world that make use of the most advances techniques and in some cases reduce the use of labor force, locating in a risk the vulnerable population due to the deeper polarization between rich and poor people. Thinking about how technologies works and what they produce and how use them to solve low-income people issues, link up the two poles (Rich and poor), creating opportunities of employment, reducing the negative impact of the technologies in weak economies.

Due to governments seek to guarantee the access of the poorest households to basic services such as water and energy; they have implemented schemes that subsidize these services in this type of homes up to 50%, as in the Colombian and Mexican case. In the case of solar panels, these subsidies straiten their savings opportunities, because, after the subsidy, the percentage of money saved by technologies has a low

impact. This also means that there is not a significant impact on the economy of families and their income distributions. Therefore, it is concluded that governments could adjust subsidy schemes in services within social housing projects in such a way that the implementation of green technologies is considered as a subsidy to these households, which in the long term will represent fewer expenses, lower real consumption of energy and opportunities for economic development in low-income households.

The current environmental issues in the entire world has created a suitable framework for the use of new sustainable technologies. Although, this notion has focused its implementation in order to resolve environmental more than economic issues. For future research, these models of social housing projects could be analyze into the model of new towns, which has presented difficulties to include social housing being this, the main objective of the public policy of Latin American countries.

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